Remedial Investigation/Feasibility Study Work Plan

Pines Area of Investigation
AOC II
Docket No. V-W-'04-C-784

Volume 2

Field Sampling Plan

ENSR Corporation

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ACRONYMS

AOC I	Administrative Order on Consent, 2003 and as amended, 2004; Docket No. V-W-03-730
AOC II	Administrative Order on Consent, 2004; Docket No. V-W-'04-C-784
ATV	All Terrain Vehicle
BERA	Baseline Ecological Risk Assessment
bgs	Below Ground Surface
CCB	Coal Combustion By-product
COC	Chain-of-Custody
CSM	Conceptual Site Model
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DQO	Data Quality Objective
EB	East Branch (of Brown Ditch)
ERA	Ecological Risk Assessment
FCO	Field Change Order
FD	Field Duplicate
FS	Feasibility Study
FSP	Field Sampling Plan
GIS	Geographic Information System
GPS	Global Positioning System
HASP	Health & Safety Plan
HHRA	Human Health Risk Assessment
HSC	Health and Safety Coordinator
ID	Identification
IDEM	Indiana Department of Environmental Management
IDNL	Indiana Dunes National Lakeshore
IDNR	Indiana Department of Natural Resources
IDW	Investigation Derived Waste
IUPPS	Indiana Underground Plant Protection Service Inc.
m	Meters
MB	Main Branch (of Brown Ditch)

MS/MSD	Matrix Spike/Matrix Spike Duplicate
MWSE	Municipal Water Service Extension
NCP	National Contingency Plan
NAD83	1983 North American Datum
NGVD	USGS National Geodetic Vertical Datum
NIPSCO	Northern Indiana Public Service Company
NTU	Nephelometric Turbidity Unit
OLQ	Office of Land Quality
ORP	Oxidation-Reduction Potential
PAH	Polycyclic Aromatic Hydrocarbon
PCDD	Polychlorinated Dibenzodioxin
PCDF	Polychlorinated Dibenzofuran
PDOP	Position Dilution of Precision
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QMP	Quality Management Plan
RB	Rinse Blank
RAL	Removal Action Level
RI	Remedial Investigation
RI/FS	Remedial Investigation and Feasibility Study
SAP	Sampling and Analysis Plan
SB	South Branch (of Brown Ditch)
SERA	Screening Ecological Risk Assessment
SMS	Site Management Strategy
SNR	Signal to Noise Ratio
SOP	Standard Operating Procedure
SOW	Statement of Work
SV	Satellite Vehicle
TAL	Target Analyte List
TBD	To Be Determined

TOC	Total Organic Carbon
TSS	Total Suspended Solids
USCS	United Soil Classification System
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USFWS	United States Fish and Wildlife Service
WB	West Branch (of Brown Ditch)
WGS	World Geodetic System

STANDARD CHEMICAL ABBREVIATIONS

Al	Aluminum
Ag	Silver
As	Arsenic
B	Boron
Ba	Barium
Be	Beryllium
Ca	Calcium
Cd	Cadmium
Cl	Chloride
Co	Cobalt
Cr	Chromium
Cs	Cesium
Cu	Copper
F	Fluoride
Fe	Iron
K	Potassium
Hg	Mercury
Li	Lithium
Mg	Magnesium
Mo	Molybdenum
Mn	Manganese
Na	Sodium
Ni	Nickel
Pb	Lead
Ra	Radium (isotopes Ra-226 Ra-228)
S	Sulphur or Sulfide
Sb	Antimony
Se	Selenium
Si	Silicon or Silica
Sr	Strontium
Tl	Thallium
V	Vanadium
U	Uranium (isotopes U-234, U-235, U-238)
Zn	Zinc
$CaCO_3$	Calcium Carbonate
HCO_3	Bicarbonate
NH_4	Ammonium
NO_3	Nitrate
PO_4	Phosphate
SO_4	Sulfate

DISCLAIMER

This document is a document prepared under a federal administrative order on consent and revised based on comments received from the U.S. Environmental Protection Agency (USEPA). This document has been approved by USEPA, and is the final version of the document.

1.0 INTRODUCTION

In April 2004, the United States Environmental Protection Agency (USEPA) and the Respondents (Brown Inc., Ddalt Corp., Bulk Transport Corp., and Northern Indiana Public Service Company (NIPSCO)) signed an Administrative Order on Consent (AOC II) (Docket No. V-W-'04-C-784) to conduct a Remedial Investigation and Feasibility Study (RI/FS) at the Pines Area of Investigation, as set forth in Exhibit I to AOC II located in the environs of the Town of Pines, Indiana. AOC II (Section VII. 20) and the Statement of Work (SOW) (Task 2.1), which is provided as an attachment to AOC II, require the Respondents to develop a Field Sampling Plan (FSP) as a component of the RI/FS Work Plan. This document provides the FSP for the Pines Area of Investigation, or the Area of Investigation, and serves as Volume 2 of the overall RI/FS Work Plan. The FSP has been prepared to follow the requirements in AOC II and the SOW, as well as to be compliant with the National Contingency Plan (NCP) (USEPA, 1990).

1.1 Background

Between 2000 and 2004, the Indiana Department of Environmental Management (IDEM) and USEPA responded to homeowners by conducting sampling of private water supply wells in a portion of the Town of Pines. In some of these samples, boron (B) and molybdenum (Mo) were detected at concentrations above USEPA's Removal Action Levels (RALs) (USEPA, 1998a). These elevated concentrations in groundwater are suspected by the USEPA to be derived from coal combustion by-products (CCBs). CCBs have been disposed at a permitted Restricted Waste Facility known as Yard 520, and CCBs are suspected to have been used as fill in areas within the Area of Investigation outside of Yard 520. Yard 520 is operated by Brown Inc., and most of the CCBs at Yard 520 were generated during combustion of coal at NIPSCO's Michigan City Generating Station.

To address the boron and molybdenum detections above the USEPA RALs, the Respondents agreed to extend the municipal water service from Michigan City to selected portions of the Town of Pines. This agreement was documented in an Administrative Order on Consent, referred to as AOC I. Additional sampling of other private wells within the Area of Investigation by USEPA indicated some concentrations near or exceeding USEPA RALs. To address this, the Respondents voluntarily approached the USEPA to discuss extending the municipal water service to a larger area, under an amendment to AOC I. Figure 1-1 is an aerial photograph that shows the Pines Area of Investigation, including areas previously connected to municipal water (North Area and South Area under AOC I) and areas connected to municipal water under AOC I (amended).

Figure 1-2 is a U.S. Geological Survey (USGS) map that provides the location of the Area of Investigation and identifies some of the aquatic features of the area. Figure 1-3 is a detailed, two-foot contour, topographic basemap of the Area of Investigation that was commissioned by the Respondents. The area was flown on March 13, 2004, and the basemap prepared by Air Maps Inc. of

Elkhart, Indiana. Figure 1-3 identifies topographic, surface water, and man-made features, including Yard 520. Figure 1-4 shows the locations of existing monitoring wells associated with Yard 520.

The Respondents also signed AOC II which requires them to conduct an RI/FS for the Area of Investigation, as identified in the Order. Under the SOW, Task 1 is the preparation of a Site Management Strategy (SMS). A draft SMS document, which outlined a preliminary conceptual model, data gaps, and the strategy for certain elements of the RI/FS, was submitted to USEPA in June 2004. A revised SMS was submitted in September 2004 and conditionally approved by USEPA in November 2004. Task 1 of the SOW was completed with the submission of the Final SMS in January 2005 (ENSR, 2005a).

Task 2 for the RI/FS for the Pines Area of Investigation is preparation of the RI/FS Work Plan. The Work Plan has been developed in seven volumes, which together provide the comprehensive approach and specific details for conducting the RI/FS for the Area of Investigation. These volumes are as follows:

- Volume 1 - Work Plan Overview
- Volume 2 - FSP
- Volume 3 - Quality Assurance Project Plan (QAPP)
- Volume 4 - Health and Safety Plan (HASP)
- Volume 5 - Human Health Risk Assessment (HHRA) Work Plan
- Volume 6 - Ecological Risk Assessment (ERA) Work Plan
- Volume 7 - Quality Management Plan (QMP)

The SMS serves as the basis for development of the RI/FS Work Plan, including this FSP. The FSP provides guidance for the RI field investigation by defining in detail the sampling and data-gathering methods to be used to meet the objectives of the investigation. The remainder of this section provides additional detail on the scope of the overall RI/FS (Section 1.2), the specific objectives of the RI (Section 1.3), the FSP Approach is presented (Section 1.4) and the data quality objectives (DQOs) (Section 1.5). The rest of the document presents a detailed description of the field activities planned as a part of the RI.

1.2 Overall Objectives of the RI/FS

The overall objectives of the RI/FS as set forth in the SOW are:

(a) To determine the nature and extent of constituents in the Area of Investigation and any threat to the public health, welfare, or the environment caused by releases or threatened releases of constituents related to CCBs at or from the Area of Investigation by conducting a RI.

(b) To collect data necessary to adequately characterize, for the purpose of developing and evaluating effective remedial alternatives, the following:

i) Whether the water service extension installed pursuant to AOC I and AOC I as amended is sufficiently protective of current and reasonable future drinking water use of groundwater in accordance with Federal, State, and local requirements;

ii) Whether there are significant human health risks in the Area of Investigation associated with exposure to CCBs; and

iii) Whether CCB-derived constituents may be causing unacceptable risks to ecological receptors.

(c) To determine and evaluate alternatives for remedial action to prevent, mitigate, control or eliminate risks posed by any release or threatened release of constituents related to CCBs at or from the Area of Investigation, by conducting a FS.

Implementation of the RI will provide the data necessary to conduct the HHRA and ERA to appropriately evaluate potential current and reasonably forseeable future risks to human health and ecological receptors. If an unacceptable risk is identified, the FS will evaluate the alternative remedial actions to address the risk.

1.3 RI and FSP Objectives

The SMS provides a review of available information, summarizes that information into a preliminary Conceptual Site Model (CSM), and based on the preliminary CSM, identifies data gaps to be addressed in the RI/FS. The sampling activities proposed in this FSP are intended to address the general data gaps and strategy items identified in the SMS.

To implement the RI in an efficient and focused manner, it is necessary to first obtain the information needed to complete the CSM, and then refine that model as needed to answer outstanding questions or fill data gaps. To achieve these objectives, the RI will be implemented using a phased approach. To understand this phased approach, it is necessary to understand how the data will be evaluated. The data collected during the RI are to be used to conduct both a human health and an ecological risk assessment.

Objectives of the Human Health Risk Assessment. One objective of the RI is to determine if groundwater quality is impacted by CCB-derived constituents in portions of the Area of Investigation that do not have municipal water service; the HHRA objective is to use these data to determine whether remedial actions need to be evaluated for these areas. Another objective of the HHRA is to determine whether CCBs outside of Yard 520 but within the Area of Investigation pose a risk to human health via direct contact. In addition, the HHRA will evaluate potential human exposure to CCB-derived constituents that may have migrated to surface water and sediments, either due to run-off or from groundwater transport.

Objectives of the Ecological Risk Assessment. The ERA will be conducted to determine whether there are risks posed to ecological receptors by CCB-derived constituents present in the aquatic environment, most notably the Brown Ditch system, but also including other relevant surface water bodies and wetlands areas within the Area of Investigation. In addition, potential risks to receptors within the terrestrial environment will be addressed where CCBs are present at the ground surface in locations that overlap areas of significant ecological habitat.

1.4 FSP Approach

To achieve the project objectives as identified in Sections 1.2 and 1.3, it is first necessary to further develop the CSM by performing the RI, which will consist of the following:

- Characterization of potential sources, including distribution of CCBs;
- Geologic/hydrogeologic characterization;
- Characterization of groundwater/surface interactions;
- Characterization of the nature and extent of CCB-derived constituents in groundwater and other media, including evaluating fate and transport of CCB-derived constituents; and
- Characterization of ecosystems/habitats.

The approach to this further characterization of the Area of Investigation is presented below. The investigations are discussed by system, followed by a discussion of the sampling to be conducted to evaluate chemical and physical characteristics in each medium. A discussion of how this information will be used in a phased approach to evaluate potential human health and ecological risks is then presented.

1.4.1 Evaluation of CCBs as Potential Sources

CCBs have been identified as potential sources within the Area of Investigation including CCBs deposited at Yard 520 and the presence of suspected CCBs used as fill outside of Yard 520. The chemical and physical characteristics of these CCBs will be evaluated through implementation of two previously-submitted sampling plans: the Municipal Water Service Extension (MWSE) Sampling and Analysis Plan (SAP) (ENSR, 2004), conditionally approved by USEPA in March 2005, and Yard 520 SAP (ENSR, 2005b), conditionally approved in August 2005. Additional investigation activities for evaluating CCBs under the FSP include sampling of CCBs from Yard 520, and a visual inspection program to determine where suspected CCBs are present outside Yard 520. Based on these evaluations, the need for further information regarding the nature or extent of suspected CCBs will be determined, and follow up work implemented if necessary.

Suspected CCBs will be evaluated for both chemical and physical characteristics. Suspected CCB sampling is being conducted under the MWSE SAP (ENSR, 2004), the Yard 520 SAP (ENSR, 2005b), and this FSP. The MWSE SAP was conditionally approved by USEPA in March 2005. Sampling was conducted under the MWSE SAP from September 2004 through August 2005. The Yard 520 SAP (ENSR, 2005b) was conditionally approved by USEPA in August 2005; initial sampling will take place in September 2005. These two SAPs were developed to characterize the chemical composition and physical characteristics of suspected CCBs outside of Yard 520 and to identify appropriate parameter groups for the RI/FS.

The data obtained will be compared to the preliminary human health and ecological screening levels (see Volumes 5 and 6 of this RI/FS Work Plan for further detail on these screening levels). These data will be used to determine if direct contact with CCBs by either human or ecological receptors poses potential risks above USEPA target risk levels and/or whether concentrations are consistent with background levels. In addition, these data will be used in conjunction with groundwater quality data to assess the extent to which CCBs may be contributing to the presence of boron and molybdenum, and/or other constituents above appropriate screening levels in groundwater.

Three CCB samples from the Type II (North) Area at Yard 520 will be collected and analyzed for metals. The data collected from these samples in conjunction with results from samples collected under the MWSE SAP will be used to focus the proposed parameter list for the RI/FS.

In addition, geologic conditions in the southern portion of the Area of Investigation will be evaluated by researching the presence or absence of a surficial aquifer in this area. The southern portion of the Area of Investigation is that area generally south of the Pines Landfill, including the south end of Ardendale and Old Chicago Road (i.e., the area where the surficial aquifer may not be present). According to studies conducted by the USGS (e.g., Shedlock et al., 1994), a surficial aquifer may not be present in this area or may not be present with sufficient capacity to support a drinking water supply. If either of these is true, and there is no potential for CCB-derived constituents to be present in other aquifers in this area, further investigation of CCB-related constituents in groundwater in this area is not warranted.

After suspected CCB evaluation activities detailed in the SAPs and this FSP are completed, the need for additional data collection activity will be considered.

1.4.2 Geology/Hydrogeology Characterization

The objectives of the characterization of geology and hydrogeology are to provide geologic information to refine the CSM; collect groundwater elevation data to determine groundwater flow directions (both horizontal and vertical), recharge and discharge locations, and seasonal variability; characterize the hydrogeology for calculating groundwater flow and migration rates; and evaluate fate and transport of constituents in groundwater and potential impacts to surface water. The data will be collected by installing monitoring wells/piezometers, logging the geologic materials encountered, collecting groundwater and surface water level measurements from wells, piezometers, and staff gauges on a seasonal basis, and conducting hydraulic testing (i.e., slug tests). Geologic cross-sections will be prepared based on the geologic data collected (described further in Section 2.2.3). A numerical groundwater flow model will be constructed to quantify the direction and rates of groundwater flow based on the hydrogeologic data collected. The results of these investigations will be evaluated to determine whether additional information would be needed from an additional phase of investigation.

1.4.3 Groundwater – Surface Water Interactions

The interaction between groundwater and surface water will be evaluated to understand where and how much groundwater discharges/recharges to Brown Ditch, the rates of surface water flow in Brown Ditch, and seasonal changes. Data collection will include the installation of piezometers adjacent to staff gauges, measurement of groundwater and surface water elevations, and measurements of flow in Brown Ditch. If indicated by the results of the initial groundwater investigation, these interactions may be evaluated for additional water bodies in an additional phase of investigation.

1.4.4 Nature and Extent of CCB-Derived Constituents in Groundwater and the Environment

During the RI, samples of groundwater, surface water, sediment, and suspected CCBs will be collected and analyzed for chemical and physical characteristics. This sampling and analysis will be the basis for evaluating the presence of CCB-derived constituents in these media, developing an understanding of the environmental chemistry of CCB-derived constituents versus constituents present in groundwater due to other potential sources, and evaluating the fate and transport of CCB-derived constituents in the environment.

Groundwater quality. Information pertaining to groundwater quality will be gathered for three key areas:

1. The area directly north of Yard 520 (labeled South Area on Figure 1-1) where municipal water has been provided;

2. The area northeast of Yard 520 (labeled North Area on Figure 1-1) where municipal water has been provided, and

3. The remainder of the Area of Investigation, primarily where there is no municipal water service.

The nature and extent of CCB-derived constituents in groundwater in these areas will be determined to the extent necessary to adequately evaluate potential current and reasonably foreseeable future risks. This includes developing an understanding of general groundwater quality conditions in these areas as well as upgradient concentrations through the sampling and analysis of groundwater. Four seasonal sampling events will be conducted for groundwater quality. Geochemical conditions affecting migration will also be evaluated. The need for any additional sampling activities will be determined after the data are evaluated.

Surface water and sediment quality. Data on surface water and sediment quality is necessary to support the evaluation of the potential human health and ecological risks associated with CCB-derived constituents in Brown Ditch. Investigations evaluating surface water and sediment quality will include synoptic collection of surface water samples and sediment samples in the various branches of Brown Ditch, and in background areas. It is anticipated that additional investigation would be needed for further evaluation of surface water and/or sediment quality only if groundwater containing CCB-derived constituents is found to discharge to other surface water bodies or wetlands, or if there is significant downstream transport of CCB-derived constituents in Brown Ditch.

1.4.5 Ecological Setting/Habitat

Habitat identification and assessment will be conducted to support aquatic and terrestrial investigations, as well as to support the ERA. Initial work will focus on evaluating aquatic habitats, such as benthic and fish communities potentially found in the drainage ditches and other relevant water bodies as well as terrestrial habitats located in areas potentially affected by CCBs placed as fill.

General ecological habitats will be identified from a combination of maps, aerial photographs, previous surveys and inventories (including those provided by National Park Service), and other available literature sources. Based on this information, a preliminary ecological habitat map will be prepared, which will be ground-truthed by field reconnaissance. It is anticipated that additional investigations, consisting of an evaluation of additional wetland or terrestrial habitats, would be conducted only if necessary based on the results of the evaluation of potential sources and the groundwater investigation.

1.5 Data Quality Objectives

The FSP has been designed to ensure that sample collection and analytical activities are conducted in accordance with technically acceptable protocols and that the data collected meet data quality objectives (DQOs). All sampling and analyses performed shall conform to USEPA direction, approval, and guidance regarding sampling, quality assurance/quality control (QA/QC), data validation, and chain-of-custody procedures, and in accordance with the project QAPP, which is provided as Volume 3 of this RI/FS Work Plan. Specific DQOs are provided in the QAPP. Validated data collected under this FSP shall be of sufficient quality to use in the HHRA and ERA.

2.0 FIELD CHARACTERIZATION ACTIVITIES

This section of the FSP presents in detail the objectives of the RI and the work designed to meet those objectives. It addresses the work that will be conducted and why it will be undertaken. The specific field procedures detailing how that work will be conducted are presented in Section 3.0 of this FSP.

It is recognized that some data gaps may remain at the completion of the work proposed in this FSP. At this time, it is not possible to say which or what type of data gaps may remain. The need for and focus of additional work will be decided once these data are collected and evaluated. Therefore, the need for and specifics of any additional work will be decided after the completion of the work specified in this FSP.

2.1 Evaluation of Potential Sources

Detections of boron and molybdenum in certain private wells are suspected by the USEPA to be derived from CCBs (SMS, ENSR, 2005a). CCBs are present within the Area of Investigation at Yard 520 and are suspected to have been used as fill outside of Yard 520. The RI includes chemical and physical characterization and verification of the locations of suspected CCBs in the Area of the Investigation, as described in the tasks below.

It must be recognized that all the CCB-derived constituents are naturally occurring in geologic materials, and that there are also other man-made sources of these constituents to the environment, including among others, septic systems and municipal landfills. Although these other sources will not be sampled directly, the results of the sampling summarized in this section and in Section 2.4 will be used to evaluate potential contributions from other sources and their importance within the Area of Investigation. Per AOC II, the Respondents will address CCB-derived constituents, but not constituents from other sources.

2.1.1 Objectives

The objective of investigating potential sources is to understand the behavior of CCB-derived constituents in the environment in the Area of Investigation. This objective will be achieved by the following:

- Quantifying constituent concentrations of metals and certain other inorganic constituents in CCBs to which human and ecological receptors may be exposed;
- Quantifying constituent concentrations of metals and certain other inorganic constituents in CCBs within Yard 520;
- Identifying the locations of CCBs within the Area of Investigation;

- Determining whether additional parameter groups (polycyclic aromatic hydrocarbons (PAHs), polychlorinated dibenzodioxins and dibenzofurans (PCDDs/PCDFs), and radionuclides) should be evaluated in addition to metals; and
- Evaluating whether constituents may migrate from CCBs to groundwater at concentrations above risk-based screening levels and background (see the HHRA Work Plan and the ERA Work Plan in Volumes 5 and 6, respectively).

2.1.2 Sampling of Suspected CCBs Encountered During Water Line Installation

Sampling of suspected CCBs and of native/background soils was conducted during the installation of a municipal water service line under the MWSE SAP (ENSR, 2004). Although the MWSE SAP pre-dates this FSP, the sampling and analysis are consistent with procedures and protocols outlined herein.

Background and Objectives. As documented in the SMS, there are reports of CCBs used as road base and/or fill in certain areas of the Area of Investigation (see Figure 2-3). As part of the extension of the municipal water service under AOC I (amended), utility trenches have been excavated along many streets, including areas where CCBs are reported to have been placed. These excavations provided an opportunity to observe the nature of the subsurface in those areas and collect samples of suspected CCBs for general characterization purposes. Native soils were also sampled and analyzed to evaluate background conditions and provide a baseline for comparison with suspected CCB samples.

Sampling Summary. The following tasks have been implemented as a part of the MWSE SAP:

- Geologic logging of utility trenches with regard to the presence of suspected CCBs and native soils; and
- Collection of samples (both suspected CCBs and native soils) for laboratory analysis for Target Analyte List (TAL) metals, plus boron, molybdenum, sulfur (S), and silicon (Si) (see Table 2-1).

Under the MWSE SAP, samples of suspected CCBs have been collected from the municipal water service utility trenches. Figure 1-1 shows the area where the municipal water service is being installed, thus depicting the spectrum of potential sample locations. Also, native soil samples have been collected from the utility trenches in areas where no suspected CCBs are present. The analytical results of these samples will be compared to the analytical results from the suspected CCB samples to evaluate whether the constituent concentrations in suspected CCBs are above background levels. Because a definitive identification of CCBs cannot be made in the field, additional evaluation or study will also be performed to verify whether the suspected CCBs are in fact CCBs or another type of fill.

The Respondents are in the process of evaluating laboratory and test methods to be used to determine, to the degree possible, whether suspected CCBs are actually CCBs.

Status of Sampling. Between September 2004 and August 31, 2005, 34 suspected CCB samples and 12 native soil samples were collected and submitted for laboratory analysis in accordance with the MWSE SAP (ENSR, 2004) as shown on Table 2-1. Figure 2-1 shows the locations of these samples. No additional sampling is anticipated under this SAP.

2.1.3 Sampling of CCBs at Yard 520 (Yard 520 SAP)

The sampling and analysis of CCBs within Yard 520 and at native/background soil locations is detailed in the Yard 520 SAP (ENSR, 2005b). Although submission of the Yard 520 SAP pre-dated this FSP, the sampling and analysis are consistent with procedures and protocols outlined herein.

Background and Objectives. As documented in the SMS (ENSR, 2005a), a literature review suggests that PAHs, radionuclides, and PCDDs/PCDFs are not typically present at concentrations of concern in CCBs. While some radionuclides tend to be present in CCBs, they are at concentrations typical of many natural materials. PCDDs/PCDFs can be generated during combustion of municipal wastes, but they typically are not created during combustion of coal. Although CCBs might contain some residual amounts of unburned coal or carbon, it typically is not in the form of potentially carcinogenic PAHs. However, the USEPA has requested limited sampling of CCBs within the Area of Investigation to confirm that these constituents are not of concern. To meet this objective, samples of CCBs will be collected within Yard 520 and analyzed for PCDDs/PCDFs, radionuclides, and PAHs during implementation of the Yard 520 SAP. Also, samples of native soils will be collected for analysis of PCDDs/PCDFs, PAHs, radionuclides, and inorganics to provide a baseline for evaluation of the CCB analytical results.

If the sample results show that PCDDs/PCDFs, radionuclides, and PAHs are not present in CCBs above background levels or above risk-based screening levels, these parameters will not be further evaluated. Only if the analytical results show one or more of these constituents are present in CCBs at a level above both background levels and the risk-based screening levels would additional evaluation be considered.

Sampling Summary. Under the Yard 520 SAP (ENSR, 2005b), ten CCB samples will be collected from the Type III (South) Area of Yard 520, as shown on Figure 2-1. Direct push (e.g., Geoprobe®) techniques will be used to collect subsurface CCB samples from within the Type III (South) Area at Yard 520. Although Yard 520 consists predominantly of CCBs, other material may be encountered, such as interim cover material used during operation of the facility and the final cover materials. Therefore, materials encountered will be logged, and only those materials that appear to be CCBs will be submitted for analysis. More detailed discussion of the proposed sampling program and rationale behind the selected sample locations is provided in the Yard 520 SAP (ENSR, 2005b).

Twenty-five samples of native soil will also be collected from within or near the Area of Investigation under the Yard 520 SAP to determine background conditions. These samples will be surface samples (0 to 6 inches below ground surface (bgs)) to document the typical background exposure point concentrations within the Area of Investigation. Proposed sample locations are shown on Figures 2-1 and 2-2. The analytical program is summarized on Table 2-1.

All samples will be submitted for laboratory analysis of PCDDs/PCDFs, radionuclides, and PAHs. Background soil samples will also be analyzed for TAL metals and boron, molybdenum, sulfur, and silicon to provide background information about these constituents. The concentrations of constituents in the CCB samples will be compared to concentrations in background samples and to risk-based screening levels (see the HHRA Work Plan and the ERA Work Plan in Volumes 5 and 6, respectively).

Status of Sampling Program. The Yard 520 SAP was conditionally approved by USEPA in August 2005. Sampling of CCBs at Yard 520 will take place in September 2005.

2.1.4 Additional Sampling of CCBs at Yard 520

In addition to sampling CCBs for PCDDs/PCDFs, radionuclides, and PAHs under the Yard 520 SAP, additional CCBs samples will be collected from the Type II (North) Area at Yard 520 under this FSP. The samples will be analyzed for TAL metals plus boron, molybdenum, silicon, and sulfur; and, in conjunction with the suspected CCBs encountered in the utility trenches (under the MWSE SAP), will be used to focus the parameter list for the RI. For example, mercury (Hg) is not currently included as a parameter in this FSP because published information suggests it is not a significant component of CCBs, a finding confirmed by the samples collected under the MWSE SAP. If Hg is measured at higher levels (i.e., levels of concern) in the CCBs from the Type II (North) Area of Yard 520, the parameter list for the RI will be re-evaluated.

Three soil borings will be advanced using direct-push (e.g., Geoprobe®) techniques at the locations shown on Figure 2-1. According to Weaver Boos Consultants, the engineering firm for Yard 520, the Type II (North) Area appears to have been filled progressively from east to west. Sample locations were selected to provide a general cross-section through the Type II (North) Area including a general range in the likely age of materials encountered. The locations of the borings also provide a cross-sectional profile through the topographically highest point of Yard 520.

Soil borings will be advanced into fill materials until underlying native soils are encountered. The materials encountered will be geologically logged. Based on the material observed, one sample interval from each boring will selected for laboratory analysis. The Type II (North) Area at Yard 520 is known to have received a small amount of non-CCB materials including concrete, brush-clearing debris, demolition debris, and steel slag. If encountered, these materials will not be selected for laboratory analysis. Any native soils or interim cover will also be excluded. To the extent possible, the samples submitted for analysis will visually appear to be suspected CCBs. At each sample location, additional sample volume will be collected and placed in a clean, wide-mouth glass jar (approximately

1 to 2 liters). This sample will be retained and may be used for later visual inspection and chemical/physical analysis if needed for further characterization.

The three samples will be analyzed for TAL metals, boron, molybdenum, silicon, and sulfur as outlined on Table 2-1. Specific procedures to be followed during sampling are presented in Section 3.0 of this FSP. A piezometer will be installed in one of these borings to evaluate groundwater levels, as described in Section 2.2.4.

2.1.5 Distribution of Suspected CCBs – Visual Inspections

Figure 2-3 presents a summary of information from a variety of unverified sources on the potential locations of CCBs within the Area of Investigation. This figure was originally presented as Figure 3 of the SMS; the basis of the information is provided in Appendix F of the SMS (ENSR, 2005a). During the RI, this information will be updated with any other information that may be available on possible locations of CCBs. The presence of suspected CCBs at these locations will then be verified in the field by visually inspecting the ground surface and shallow subsurface. The overall objective of these visual inspections is to determine where suspected CCBs are located in the Area of Investigation. These inspections will help define the extent of suspected CCBs within the Area of Investigation.

Visual inspection of the surface materials will be conducted as per methods described in Section 3.3.2. The native soils in the Area of Investigation are typically white to tan sands in uplands and fine-grained organic soils in the lowlands. It is anticipated that fill materials, including but not limited to suspected CCBs, will have a distinctly different appearance in the field. The suspected CCBs in the water service utility trenches are black and clearly different than the native soils. The visual inspections are expected to be sufficient to distinguish suspected CCBs from native soils. However, the identification of whether a material is a CCB (versus another type of fill material) and, if so, what type of CCB (e.g., fly ash, bottom ash, etc.) will not be conclusively made in the field. For example, bottom slag from coal combustion (a CCB) may appear in the field similar to steel-making slag (not a CCB). Therefore, non-native materials having a visual appearance consistent with CCBs will be referred to as "suspected CCBs," and use of the term CCB with respect to these materials, based on visual appearance in the field, is not a conclusive determination.

If the risk assessment indicates that there are unacceptable risks associated with direct exposure to CCB materials, then additional, more detailed information may be collected concerning the extent and vertical dimensions of suspected CCBs within the Area of Investigation.

2.1.6 Physical Characteristics of CCBs

Suspected CCBs encountered during installation of the municipal water service extension have been submitted for laboratory constituent analysis. Additional sample volume is being collected and archived as specified in the MWSE SAP (ENSR, 2004). Approximately ten samples of suspected

CCBs will be submitted for physical testing, including grain size and bulk density. The purpose of physical testing is to provide data for use in the risk assessments and evaluation of fate and transport (e.g., dust generation). Physical testing data might also be used as a diagnostic tool to help distinguish CCBs from other materials such as steel slag. Approximately ten of the native soil samples collected under the MWSE SAP and five of the background samples collected under the Yard 520 SAP, for a total of 15 background samples, will also be submitted for physical testing. The specific samples to be submitted will be selected after the sampling is complete and laboratory analytical results have been received and validated. Samples will be selected such that data are obtained for different types of native soils encountered, and different types of CCBs, if appropriate. As detailed on Table 2-1, a total of approximately 10 samples of suspected CCBs and 15 background samples will be submitted for this testing.

As noted above, a conclusive identification of CCBs cannot be made in the field based solely on visual appearance. It is expected that additional testing or studies will be used to conclusively identify whether suspected CCBs are CCBs. The Respondents are in the process of evaluating laboratory and test methods to be used to determine, to the degree possible, whether suspected CCBs are actually CCBs.

2.1.7 CCBs as a Potential Source to Groundwater

An approach for evaluating CCBs as a source to groundwater is presented in the SMS (ENSR, 2005a). That approach has been refined in this FSP to provide information more directly. The following work will be performed to evaluate potential leaching from CCBs to groundwater. These activities are described in detail in subsequent sections of this FSP.

- Installation of three wells is proposed in the vicinity of the suspected CCB fill areas as described in Section 2.2 below. Based on observations during installation of the municipal water service extension, three wells (on Central, Second Place, and East Johns, denoted G, H, and I on Figure 2-4) are anticipated to be installed through suspected CCB deposits. Analytical results of samples from these wells will aid in evaluating potential leaching to groundwater.
- Groundwater monitoring data have been collected from wells at Yard 520 from at least 1989 to the present. These data were collected using methods and procedures that are different from those intended for the RI/FS. However, the data are suitable for some uses in the RI in accordance with criteria provided in the QAPP. In particular, these data will be examined to evaluate conceptually which constituents may leach from CCBs, and what relationships there may be among the constituents. Concentration trends over time and seasonal variability can also be examined. This information will be used to refine the RI sampling program and support interpretation of data collected during the RI.

- As detailed in Section 2.4 below, groundwater samples will be collected under this FSP from several monitoring wells located along the northeastern portion of Yard 520, including TW-15S, TW-15D, TW-16S, TW-16D, TW-18S, and TW-18D (see Figure 1-4). Data from these wells will be used to evaluate migration from CCBs to groundwater.

2.1.8 Evaluation of Conditions in the Southern Portion of the Area of Investigation

The USEPA and IDEM have identified, by private well sampling, areas within the Town of Pines where boron and molybdenum exceed current USEPA RALs (USEPA, 1998a). These areas are generally in and near the North Area and South Areas (as shown on Figure 1-1). Private well sampling has also identified sporadic instances in the southern portion of the Area of Investigation outside the municipal water service area that have exceedances of one of the USEPA RALs, typically molybdenum detected at low concentrations just above its RAL.

Based on a preliminary review of USGS geologic information (e.g., Shedlock, et al., 1994), the surficial aquifer pinches out to the south against the geologic materials of the Valparaiso Moraine. The southern limit of the surficial aquifer appears to be near the southern portion of the Area of Investigation. Therefore, private wells in this area were likely drilled into the deeper confined aquifers because of the lack of significant water in the surficial aquifer (due to its thinness or absence). The locations of these wells, geologic conditions in the area, and no known or reported CCBs in the area suggest the molybdenum is less likely to be attributed to the CCBs, although this cannot yet be ruled out. Other potential sources may include: natural background (either in the surficial or in deeper aquifers), septic systems, former municipal landfills, or other as of yet unidentified sources. At a public meeting on April 19, 2005, the USEPA presented tritium and boron-isotope ratio data indicating that certain other occurrences of boron and molybdenum in private wells outside the Area of Investigation are related to natural, deep groundwaters rather than CCBs. As a result, these wells are now believed to be screened in deeper confined aquifers.

The presence of boron and molybdenum in groundwater in the southern portion of the Area of Investigation will be evaluated by initially conducting further research into publicly-available sources of information, as follows:

- Well records retained by the Indiana Department of Natural Resources (IDNR) will be reviewed in detail for the southern portion of the Area of Investigation. This detailed review will include depths of wells at specific addresses as well as general well depths in the area. Where geologic information is reported in these records, it will also be considered. Copies of many of the IDNR well records are included in the SMS (ENSR, 2005a).

- USGS regional geologic studies will be reviewed in more detail for information about the absence/presence and potential yields of the surficial aquifer in the southern portion of the Area of Investigation.

- Any available water quality data from the Pines Landfill and the Lawrence Dump (located south of Railroad Avenue, west of Ardendale, and north of Old Chicago), and from regional USGS studies on background conditions will be reviewed to determine if there are any relevant data.
- As detailed in Section 2.6, three private wells in this area known or suspected to be set below the surficial aquifer will be sampled. The samples will be analyzed for an extensive analyte list to characterize conditions in the confined aquifer(s).

Based on the results of this research and evaluation, additional work may be proposed. If the review of available records indicates that a surficial aquifer is not present in this area, or is not present with sufficient capacity to support a drinking water supply, and there is no potential for CCB-derived constituents to be present in other aquifers in this area, further investigation of CCB-related constituents in groundwater in this area is not warranted. Based on the information presented in the April 19, 2005 public meeting, it appears that tritium and boron-isotope ratio data may be effective for distinguishing among sources of boron in groundwater. These methods will be included in the FSP sampling program. If it appears that the surficial aquifer is present in this area, additional field investigation may be needed.

2.2 Geologic and Hydrogeologic Characterization

The RI will include collection of data to characterize the geology and hydrogeology within the Area of Investigation as detailed below.

2.2.1 Objectives

The objectives of the geologic and hydrogeologic characterization include:

- Collecting sufficient data to quantify the direction of groundwater flow, the seasonal variability in groundwater flow, and to evaluate groundwater flow variability due to heterogeneities in geologic and/or fill materials.
- Collecting sufficient data to estimate rates of groundwater flow and constituent migration;
- Updating information about groundwater usage in the Area of Investigation; and,
- Providing sufficient data to construct and calibrate a numerical groundwater flow model to evaluate groundwater flow directions in the future and potential migration of CCB-derived constituents in groundwater.

These objectives will be achieved by implementing the activities outlined in the following sections.

2.2.2 Installation of Monitoring Wells

Twenty-three monitoring wells are proposed to be installed within and around the Area of Investigation. The monitoring well locations were generally selected based on the detections of boron and molybdenum in private well samples, and the conceptual understanding of groundwater flow directions based on USGS regional studies and local studies at Yard 520. However, to meet the project objectives, wells are proposed in both expected up- and down-gradient directions, as well as at and across expected groundwater divides. So while the proposed well locations are based on expected flow directions, their usefulness is not dependent on these flow directions.

These wells, in addition to accessible pre-existing monitoring wells, will be used to define hydrogeologic conditions throughout the Area of Investigation and serve as potential locations for groundwater sampling (see Section 2.4). Pre-existing monitoring wells include wells associated with Yard 520 (see Figure 1-4), wells associated with the Pines Landfill, and wells installed by the USGS (see Figure 2-11). Well construction information for Yard 520 wells is provided on Table 2-2.

Water level information will also be obtained from piezometers and staff gauges in surface water bodies (see Section 2.3), which will supplement the water level data from the monitoring wells.

The details of the well drilling and installation methods are discussed in Section 3.0. Soil borings will be extended to the confining clay unit. Wells will generally be screened at the water table (unless there is information supporting an alternative screened interval), and constructed with 15 feet of polyvinyl chloride (PVC) screen.

The locations of the wells to be installed are shown on Figure 2-4. Final locations may be modified based on private property access and field conditions.

The rationale for the well locations is as follows:

- Seven wells (denoted A through E, V, and W on Figure 2-4) will be installed generally north of Yard 520, (i.e., the South Area shown on Figure 1-1). The proposed wells, in conjunction with wells at Yard 520, will provide hydrogeologic information in this area, including groundwater flow directions. The wells will also provide chemical characterization of the center and edges of the boron and molybdenum occurrences in this area (see Section 2.4), including to the northeast of Yard 520.
- Five wells, denoted F through J on Figure 2-4, will be installed in the vicinity of the North Area (shown on Figure 1-1). These five wells will provide hydrogeologic characterization in this area, including hydraulic gradients. Three of the wells (denoted G, H, and I on Figure 2-4) are anticipated to be installed through suspected CCB materials, based on information from the water service installation. If these materials are confirmed to be CCBs, laboratory analysis of samples from these wells will aid in evaluating potential leaching from CCBs

(see Section 2.1.7), and will help evaluate the distribution of CCB-derived constituents in groundwater in this area.

- An additional well is proposed south of this area near Brown Ditch (location K). The placement of this well is designed to provide information on hydrogeologic conditions, hydraulic gradients, and groundwater-surface water interactions.
- Six other monitoring wells (L through Q) are proposed to evaluate general groundwater quality and hydrogeologic conditions in other parts of the Area of Investigation, including areas not scheduled to receive municipal water service.
- Four wells (R through U on Figures 2-2 and 2-4) are proposed at upgradient locations. In addition to providing hydrogeologic information at the edges of the Area of Investigation, these wells will provide data on upgradient/background groundwater quality. One of these wells (T) is placed within the Indiana Dunes National Lakeshore (IDNL), in a location not expected to be downgradient from the Area of Investigation.

The specific data to be collected from these wells is discussed below and in Section 2.4.

2.2.3 Geologic Data Collection

During installation of the monitoring wells, continuous soil samples will be collected, and the observed materials will be logged (see Section 3.3.6). The boreholes will be extended to the top of the confining clay layer, so that the clay elevation and saturated thickness of the surficial aquifer can be determined.

The geologic data collected during the advancement of the borings coupled with information from existing wells (USGS and/or Yard 520), borings, and test pits will be used to prepare geologic cross-sections. The purpose of preparing cross-sections is to depict the regional geology as part of the overall conceptual model, and to support development of the numerical groundwater flow model. It is anticipated that at least three cross-sections will be developed, one east-west and two north-south through the Area of Investigation. The east-west cross-section will be placed between West Dunes Highway (US Route 12) and US Highway 20, through the primary residential area. The two north-south cross-sections are anticipated to be through the former North and South Areas (see Figure 1-1), including Yard 520 and Brown Ditch. Depending on the data obtained, additional cross-sections and/or more detailed, local-scale cross-sections may also be prepared.

2.2.4 Water Level Monitoring

Water levels will be measured a total of five times (once a calendar quarter, see schedule in Section 4.0) at the proposed monitoring wells to determine hydraulic gradients and groundwater flow directions in the surficial aquifer on a seasonal basis. Water levels will be collected at the surface water and groundwater monitoring points installed under this plan, and at all existing monitoring wells at Yard

520. The measured groundwater levels will serve as a basis for calibration of a numerical groundwater flow model (Section 2.2.6).

One piezometer will be installed in the Type II (North) Area at Yard 520 to evaluate groundwater levels in this area (see Figure 2-4). Procedures for piezometer installation are presented in Section 3. Water levels will be measured at this point at the same time as measurements are taken from monitoring wells.

In addition, water levels will be measured in select USGS monitoring wells. The locations of USGS wells are shown on Figure 2-11. Wells greater and less than 30 feet deep are shown with different symbols; thirty feet was chosen as a rough approximation to identify wells that may be in confined versus unconfined aquifers. Wells less than 30 feet deep are generally assumed to be screened in the surficial (unconfined) aquifer. A subset of these wells will be chosen for monitoring during the RI based on the USGS access permission, the availability of well logs, and a field reconnaissance program which will determine which wells still exist and are suitable for taking measurements. Once the subset is determined, water levels will be recorded quarterly, at the same time as the water level measurements elsewhere in the study area. These data will be used to evaluate the hydraulic relationship between the confined aquifers and the surficial aquifer. Monitoring wells at the Pines Landfill (which is different than Yard 520) may also be used to collect water level data, if access is granted.

In general, water level measurements will be collected after several days of no rain so that surface water conditions in the ditches are most representative of baseflow conditions. Evaluation of baseflow conditions is most appropriate for evaluating the groundwater-to-surface water pathway. Because gauging will be scheduled to correspond to sampling events (see schedule in Section 4.0), the ability to adjust the schedule due to weather is limited. All water level measurements will be taken synoptically (over a short period of time).

Groundwater levels will also be electronically recorded continuously at approximately five wells over approximately a one-year period to evaluate short-term water level changes and variability between calendar quarters. Continuous water level monitoring will include at least one groundwater-surface water pair. This information will help evaluate groundwater surface water interactions and to evaluate the response of the surface and groundwater to precipitation events. In addition, a wetland location will be considered as this may aid in estimating evapotranspiration. The wells will be selected based on the results from the first round of surface water and groundwater sampling (see schedule in Section 4.0). A technical memorandum will be submitted to USEPA proposing the locations and rationale for the continuous monitoring.

2.2.5 Hydraulic Conductivity Testing

Aquifer slug testing will be performed in all new monitoring wells to determine hydraulic conductivities. In addition, slug testing is currently proposed at five Yard 520 wells: MW-1, MW-3A, MW-6, MW-11, and TW-18D (see Figure 1-4). These Yard 520 wells were selected on the basis of well construction (screened below the water table), saturated thickness (at least 7 feet), and geologic materials to be tested. Logs for Yard 520 wells are included in the Site Management Strategy (ENSR, 2005a). During the Supplemental Closure of the Type II (North) Area, some of these wells may not survive. Alternative locations for testing will be considered if this occurs. The slug tests will be performed and the data analyzed using appropriate methodologies (e.g., Bouwer and Rice, 1976; Kansas Geological Survey methods (Hyder, et al., 1994); Cooper, Bredehoeft, and Papadopulos, 1967).

2.2.6 Groundwater Flow Modeling

A numerical groundwater flow model will be developed to manage and integrate the hydrogeologic data collected, to quantify the direction and rates of groundwater flow, and to quantify the direction and rates of discharge from groundwater to surface water. The model will be calibrated to observed groundwater levels (see Section 2.2.4), as well as rates of groundwater discharge, if adequate data are available. A detailed scope of work for the modeling will be submitted to the USEPA for review in a technical memorandum, per Task 2.1 of the SOW.

Other expected uses for the model include:

- Understanding potential directions and rates of groundwater flow and CCB-derived constituent migration in the future;
- Supporting human health and ecological risk assessments by evaluating pathways and estimating exposure point concentrations, as appropriate; and
- Supporting evaluation of remedial action alternatives in the FS, as appropriate.

2.3 Groundwater-Surface Water Interaction

The RI will include collection of data to characterize groundwater-surface water interactions as detailed below.

2.3.1 Objectives

The objectives of studying the relationship between groundwater and surface water include:

- Collecting sufficient data to quantify the recharge/discharge relationships between groundwater and surface water, and their seasonality; and
- Evaluating potential impacts of groundwater discharge on surface water systems.

The work specified in this FSP is designed to meet these objectives.

2.3.2 Surface Water Levels in Ditches

Surface water levels will be measured at approximately 12 locations, a total of five times (once a calendar quarter, see schedule in Section 4.0), at locations shown on Figures 2-2 and 2-5. These surface water measurement locations are on the east, west, and main branches of Brown Ditch, on tributaries to Brown Ditch, on Brown Ditch in the IDNL, and on Kintzele Ditch. Two additional locations are also proposed in two ponds located between the residential area and the east branch of Brown Ditch. Water levels may be measured at staff gauges to be installed, or as depth to water measurements from existing structures (e.g., bridges or culverts). The surface water levels will be used in combination with groundwater levels to quantify groundwater discharge to the ditches and seasonal variability. They will also provide boundary condition inputs to the groundwater flow model.

In general, surface water measurements will be taken to represent baseflow conditions (after several days of no rain). Evaluation of baseflow conditions is most appropriate for evaluating the groundwater-to-surface water pathway. The surface water measurements will be collected at the same time as the groundwater level measurements in the wells (Section 2.2.4).

Surface water levels will also be electronically recorded continuously at two locations over approximately a one-year period to evaluate short-term water level changes and variability between calendar quarters. One location will be selected adjacent to a groundwater level monitoring point (see Section 2.2.4) to help evaluate groundwater-surface water interactions and to evaluate the response of the surface and groundwater to precipitation events. The other location will be selected at one of the flow monitoring points (see Section 2.3.4). The locations will be selected based on results from the first round of surface water and groundwater sampling (see schedule in Section 4.0). A technical memorandum will be submitted to USEPA proposing the locations and rationale for the continuous monitoring.

2.3.3 Groundwater Levels at Surface Water Bodies

At certain surface water stations, groundwater levels will be collected in addition to surface water levels. Groundwater levels will be obtained from piezometers installed through the bed of the water body and into the underlying groundwater. As shown on Figure 2-5, proposed locations for these piezometers are on the east, west, and main branches of Brown Ditch as it passes through the Area of Investigation. In addition, three piezometers (Figure 2-5) and two wells (locations V and W, Figure 2-4) will be installed in wetland areas. All locations may be adjusted based on private property access and actual field conditions.

Groundwater levels will be collected at all piezometers for a total of five times (once a calendar quarter, see schedule in Section 4.0), at the same time as other water level data are collected. These data will be used to evaluate recharge/discharge relations between the groundwater and surface water or wetlands, and how they may vary spatially and seasonally.

2.3.4 Surface Water Flow Rates

Surface water flow rates will be measured at the following locations in the Brown Ditch system (see Figure 2-5):

- Brown Ditch, east branch: Flow rates will be measured where Brown Ditch flows beneath US Highway 20 and where it flows beneath the private unpaved road that crosses the ditch as shown on Figure 2-5. The difference in flow between these stations will provide an estimate of groundwater discharge rates along the east branch of Brown Ditch.
- Brown Ditch, main branch: Flow rates will be measured where Brown Ditch flows beneath US Highway 20 and beneath US Route 12 (West Dunes Highway), as shown on Figure 2-5. The data will provide an estimate of groundwater discharge rates in this reach.
- Brown Ditch, west branch: On the west branch, there is only one man-made structure at which to measure flow, the culvert where Brown Ditch passes beneath Birch Street (see Figure 2-5). Therefore, it will be necessary to identify locations where additional measurements will be feasible, if any. The conditions along the west branch will be reviewed from the culvert to upstream of the tributary that flows south beneath the railroad (see Figure 2-5). One location along this stretch will be selected for flow measurements in order to estimate groundwater discharge rates on the west branch. The location shown on Figure 2-5 is approximate.

Surface water flow rates will be measured a total of five times (once a calendar quarter, see schedule in Section 4.0) and at the same time that groundwater levels are being collected.

The continuous monitoring of surface water levels (see Section 2.3.2 above) will be conducted over a one-year period at one of these stations to evaluate stage/discharge relationships.

2.4 Nature and Extent of CCB-derived Constituents in Environmental Media

This section describes the sampling and chemical analyses to be performed during the RI.

2.4.1 Objectives

The sampling of suspected CCBs and background/native soils and the characterization of CCBs is discussed in Section 2.1 and is not repeated here. In addition, private well sampling will also be conducted; it is described in Section 2.6.

This FSP also details the sampling of groundwater, surface water, and sediments. The purposes for these activities are:

- To evaluate the extent and concentrations of CCB-derived constituents including boron and molybdenum in environmental media within the Area of Investigation;
- To identify a suite of constituents, including boron and molybdenum, that provides an indication of CCB-derived influence;
- To identify other suites of constituents, possibly including boron and molybdenum, as appropriate, that indicate other source influences, including septic systems, natural/background, municipal landfills, etc.;
- To characterize background, upgradient surface water and sediment characteristics;
- To evaluate potential migration of constituents from CCBs to groundwater;
- To evaluate fate and transport of CCB-derived constituents in environmental media at the Area of Investigation; and
- To provide data and information for use in the HHRA and ERA.

The sampling program for each medium is described below.

2.4.2 Evaluation of Vertical Variation in Groundwater

The surficial aquifer is relatively thin (up to 30 feet of saturated thickness), however, data from monitoring at Yard 520 suggests there may be some variation in water quality vertically (i.e., a variation in constituent concentrations between groundwater at the water table and groundwater at the base of the surficial aquifer). Vertical profiling of groundwater quality will be performed at selected locations to collect data to evaluate vertical variations (locations A, F, N, O, and V on Figure 2-4). At each of these locations, a HydroPunch® or similar technique will be used to collect groundwater samples at five-foot intervals from the water table to the base of the surficial aquifer (estimated total of 20 samples). The samples will be monitored in the field for pH, specific conductance, temperature, and turbidity, and submitted for laboratory analysis for boron and molybdenum (see Table 2-1). Data on the field parameters dissolved oxygen (DO) and oxygen-reduction potential (ORP) will also be recorded, although the results are not expected to be representative of undisturbed groundwater conditions.

A monitoring well will be installed at each of the vertical profiling locations (see Figure 2-4) and will be sampled for the parameters listed on Table 2-1. The information from the vertical profiling will be used to select screened intervals (i.e., at the water table or deeper in the surficial aquifer) for the monitoring wells and to determine whether vertical variations are of consequence. If vertical profiling suggests there are significant differences between the water table and deeper portions of the surficial aquifer, well pairs will be considered.

2.4.3 Groundwater Sampling

Groundwater samples will be collected from each of the monitoring wells to be installed (Section 2.2.2), and from six existing Yard 520 monitoring wells: TW-15S, TW-15D, TW-16S, TW-16D, TW-I8S and TW-I8D, located just north of Yard 520 (see Figures 1-4 and 2-4). Groundwater samples will be analyzed for selected parameters, as specified in Table 2-1. The categories of analytes and the purposes for their analysis include:

- Field parameters to monitor the effectiveness of purging and provide geochemical information, include temperature, pH, specific conductance, DO, turbidity, and ORP. These parameters will be monitored each time a well is sampled.
- Constituents potentially associated with CCBs and used for the risk assessments, include As, B, Ba, Cd, Cu, Cr, Mn, Ni, Pb, Mo, Se, Tl, V, and Zn. If, after the third sampling event, any of these constituents are found at concentrations consistent with background or below risk-based screening levels, they will be omitted from subsequent sampling events. A list of parameters to discontinue and justification will be submitted in a technical memorandum to the USEPA for review and approval. Boron and molybdenum will be analyzed in all samples for all four sampling events.
- Constituents used to characterize general groundwater quality and potentially associated with non-CCB sources (such as septic systems, municipal landfills and/or natural groundwater), include Al, Ca, Fe, K, Na, Mg, Si, Sr, Cl, F, sulfide, nitrate (NO_3), ammonia (NH_4), sulfate (SO_4), orthophosphate (PO_4), bicarbonate (HCO_3), dissolved organic carbon (DOC), and anionic surfactants. Note that many of the metals listed in the previous bullet will also be used to evaluate general groundwater quality and non-CCB sources. A subset of these constituents is likely to be most useful in the RI. However, it is not possible to identify that subset now, as it is based on local groundwater conditions. At any time, selected constituents from this list may be dropped from further sampling events if the results are determined not to be useful as a diagnostic or characterization tool.
- Radionuclides. Isoptopes of uranium (U-234, U-235, and U-238) and radium (Ra-226 and Ra-228) will be analyzed in samples from Yard 520 wells MW-3, MW-6, MW-8, MW-10, and TW-12, the five wells where boron concentrations have been the highest during the last two years. During the Supplemental Closure of the Type II (North) Area of Yard 520, some of these wells may not survive. Alternative wells, in order of preference, include: TW-18D, MW-7, TW-15D, and TW-19D. These radionuclides will also be analyzed at the four background wells (locations R through U) and from two new wells that are anticipated to be installed through suspected CCBs (locations G and H). Well locations are shown on Figures 1-4, 2-2, and 2-4). These data will be used to evaluate background levels and potential migration of radionuclides from CCBs to groundwater. If, after the first sampling event, these constituents are found in groundwater at concentrations consistent with background or below risk-based screening levels, no further evaluation will be conducted.

- Lithium (Li) will be analyzed in samples from the same list of wells as the radionuclides to evaluate its utility as an indicator of CCBs. If it is determined to be useful as an indicator of CCBs, as suggested by literature reviewed in the SMS, it will continue to be analyzed in more wells. If it is not present or not useful as an indicator, samples will not continue to be analyzed for Li.

- Boron-isotope ratio data can be used to aid in distinguishing the influence of different sources. As presented at a public meeting on April 19, 2005, USEPA and USGS are using recently collected data on boron-isotope ratios to help understand boron sources in the Beverly Shores area and the Township School well. Therefore, each monitoring well (a total of approximately 34) will be sampled one time for boron-isotope ratios.

- Tritium (a man-made isotope of hydrogen) is used to evaluate groundwater age. Tritium was introduced into the atmosphere beginning in 1952 with the first testing of nuclear weapons. Thus, post-1952 rainwater is "tagged" with tritium, and the differences in tritium concentrations detected in groundwater can thus be used to determine the relative ages of groundwater. In the Pines Area of Investigation, tritium concentrations can be used to distinguish between "young" groundwater in the surficial aquifer (which receives tritium-tagged precipitation via infiltration) and "old" groundwater below the clay in the confined aquifers (which has been largely unaffected by tritium-tagged rainwater). As presented at a public meeting on April 19, 2005, USEPA and USGS are using recently collected tritium data to help understand boron sources in the Beverly Shores area and the Township School well. Because the monitoring wells in the Area of Investigation will be installed in the surficial aquifer, tritium is expected to be present, confirming the relatively young age of the water. However, for purposes of comparing data from shallow wells with the private well data (see Section 2.6), tritium will be analyzed in samples from approximately five monitoring wells: locations T and U (background), and A, F, and M (well locations shown on Figures 2-2 and 2-4).

As noted above, the list of selected parameters may be refined following the initial round(s) of sampling if the results are determined not to be useful as a diagnostic or characterization tool. Any changes to the parameter list will be justified and documented. Prior to discontinuing monitoring for constituents required for the risk assessment, a list of these constituents will be submitted in a technical memorandum to USEPA for review and approval.

The wells will be sampled using low-flow methods (see Section 3.0) over a one-year period, a total of four times (once each calendar quarter, see schedule in Section 4.0) to evaluate seasonal variability. Two of these events will take place during seasonal high water levels (March-April) and seasonal low water levels (September-October). After each sampling event, the list of wells and analytical parameters will be re-evaluated as described above. Those wells and parameters that will be useful to meet the objectives of the RI will continue to be monitored for the full year.

Historical data collected from other Yard 520 monitoring wells as part of other sampling programs will also be considered in the RI. Groundwater monitoring data have been collected from wells at Yard 520 from at least 1989 to the present. These data were collected using methods and procedures that are different from those intended for the RI/FS. However, the data are suitable for some uses in the RI in accordance with criteria provided in the QAPP. In particular, these data will be examined to evaluate conceptually what relationships there may be among constituents and to evaluate concentration trends over time and seasonal variability. Table 2-3 summarizes the on-going groundwater monitoring program at Yard 520.

2.4.4 Surface Water and Sediment Sampling

Surface water and sediment sampling will be conducted in the Area of Investigation and in selected upstream and regional reference locations (e.g., upstream reach of Kintzele Ditch). Proposed surface water and sediment sampling locations within the Area of Investigation are identified in Figure 2-6 and 2-7, respectively; sampling locations outside the Area of Investigation are shown in Figure 2-2. The candidate sampling locations will be identified and field located during a preliminary reconnaissance of the Brown Ditch stream corridor to be conducted with USEPA representatives, subject to private property access and field conditions. The field and analytical parameters for surface water and sediment are specified in Table 2-1.

2.4.4.1 Surface Water Sampling

Surface water samples will be collected over a one year period, a total of four times (once each calendar quarter, see schedule in Section 4.0) at the approximately 24 locations indicated on Figures 2-2 and 2-6. Surface water samples will be analyzed for selected parameters, as specified in Table 2-1. The categories of analytes and the purposes for their analysis include:

- <u>Field parameters</u> (temperature, pH, specific conductance, DO, turbidity, ORP, estimated (qualitative) flow) will be measured to monitor basic stream conditions and water chemistry. These parameters will be monitored each time surface water is sampled.
- <u>Constituents potentially associated with CCBs</u> and used for the risk assessments, include As, B, Ba, Cd, Cu, Cr, Mn, Ni, Pb, Mo, Se, Tl, V, and Zn. If, after the third sampling event, any of these constituents are found at concentrations consistent with background or below risk-based screening levels they will be omitted from subsequent sampling events. A list of parameters to discontinue and justification will be submitted in a technical memorandum to the USEPA for review and approval. Boron and molybdenum will be analyzed in all samples for all four sampling events.
- <u>Constituents used to characterize general surface water quality</u> and potentially associated with non-CCB sources (such as septic systems, fertilizers, and/or atmospheric deposition) include Al, Ca, Fe, K, Na, Mg, Si, Sr, Cl, F, sulfide, NO_3, NH_4, SO_4, PO_4, and HCO_3. At any

time, selected constituents from this list may be dropped from further sampling events if the results are not determined to be useful as a diagnostic or characterization tool.

- Other water quality parameters (hardness, dissolved organic carbon (DOC), and total suspended solids (TSS)) will be measured to monitor basic stream water chemistry. These parameters will be monitored each time surface water is sampled.

All analyses will be conducted on unfiltered samples; however, analyses for selected metals will be performed on both filtered and unfiltered samples, as indicated in Table 2-1. As noted above, the list of selected parameters may be refined following the initial round(s) of sampling if the results are determined not to be useful as a diagnostic or characterization tool. Any changes to the parameter list will be justified and documented. Prior to discontinuing monitoring for constituents required for the risk assessment, a list of these constituents will be submitted to USEPA in a technical memorandum for review and approval.

Unless otherwise agreed with USEPA, surface water samples from channel/stream environments will be taken from a mid-stream, mid-depth location, as a grab sample, taking care not to disturb or entrain bottom sediments in the water sample. Due to seasonal flow variation in upstream locations, water may not be available for sampling at all sampling events. For pond sampling, two samples may be taken, as appropriate, to evaluate depth-specific water quality for thermally stratified systems. Further details on surface water sampling procedures are provided in Section 3.0.

2.4.4.2 Sediment Sampling

Sediment samples will be collected at the approximately 20 locations indicated on Figures 2-2 and 2-7 and analyzed for the following laboratory parameters (Table 2-1):

- Metals potentially associated with CCBs and used for the risk assessments, include As, B, Ba, Cd, Cu, Cr, Mn, Ni, Pb, Mo, Se, Tl, V, and Zn.
- Metals and other inorganics to aid in interpreting geochemical conditions and potential sources, include Al, Ca, Fe, Na, Mg, K, S, and Si.
- Ancillary physical and chemical parameters of interest, including grain size, bulk density, percent moisture, and total organic carbon (TOC) will be analyzed to aid in interpreting physical conditions and depositional environments.

A preliminary reconnaissance of Brown Ditch will be conducted prior to sampling. As part of this reconnaissance, candidate sediment sample locations and sample points at each location will be identified (in consensus with USEPA) and the depth of soft sediment estimated. Sediment samples may be taken from either quiet reaches or bank deposits (or a combination), based on the nature of the sediment deposit, the local flow patterns, and/or other site-specific factors. Sediment samples will be taken in depositional environments, as available. Where no depositional areas are locally available, the sediment will be taken from a mid-stream location.

Sediment samples will be collected from the sediment surface to a depth of 12 inches with a Russian peat borer and the sample cores photodocumented. If sediment depth is less than 8 inches or a uniform clay or sand layer is encountered, a single sample from the 0 to 6 inch interval will be taken. If the sediment depth is greater, a second, deep sediment sample will be taken from the 6-12 inch interval. Chemical analyses will be conducted on all surficial sediment samples and approximately six of the deep samples. The six deep samples to be analyzed will be identified in the field in coordination with the USEPA. The additional deep sediment samples will be preserved and archived by the laboratory pending analyses of surficial sediment. At each sample location, if the concentrations of CCB-related constituents (listed above) exceed risk-based screening levels, then the deeper sample from that location will also be analyzed. Further details on sediment sampling procedures are provided in Section 3.0.

2.4.5 CCB and Soil Sampling

The sampling and analysis of CCBs and soil in the Area of Investigation has been conducted under the MWSE SAP, and will be conducted under the Yard 520 SAP (ENSR, 2004; ENSR, 2005b), and this FSP. These sampling and analysis programs are detailed in Sections 2.1.2, 2.1.3, and 2.1.4, and provide for the sampling of suspected CCBs, CCBs in Yard 520, and native/background soil.

2.5 Ecological Habitat Characterization

Ecological habitats of interest in the Area of Investigation will be identified and characterized as necessary to support the ecological investigation element of the RI, including the Screening Ecological Risk Assessment (SERA) (described in the ERA Work Plan, Volume 6 of the RI/FS Work Plan). Evaluation of ecological exposure pathways and relevant receptors will be made for an assessment of aquatic and terrestrial habitats. Based on the results of the work proposed in this FSP, additional habitat evaluation might be needed, as well as identification and assessment of additional aquatic or wetland habitats as indicated by groundwater investigations.

2.5.1 Objectives

The objective of characterizing ecosystems and habitats is to identify the basic ecological setting and habitats, their associated ecological communities, and potentially representative wildlife species that will be evaluated in the SERA. Specific objectives of ecological habitat characterization include:

- Identification of ecological habitats of interest;
- Identification of potential ecological communities and wildlife receptors of interest;

- Identification of sensitive receptors (i.e., State or Federal threatened/endangered species or species/habitats of special interest) within the Area of Investigation or in the vicinity;
- Determination of the potential overlap of ecological habitats of interest with areas of CCBs;
- Identification of potential reference or background areas for comparison; and
- Updating and refining of the preliminary ecological CSM including the exposure pathways.

2.5.2 Habitat Identification and Assessment

Habitat identification and assessment will be conducted to support the initial aquatic and terrestrial assessment portions of the SERA. Accordingly, the initial habitat identification will be conducted to support initial problem formulation, identification of ecological receptors, and confirmation of potential exposure. General ecological habitats will be identified from a combination of maps, aerial photographs, previous surveys and inventories (including those provided by National Park Service (Hicks, 2004)) and other available literature sources. Based on this information, a preliminary ecological habitat map will be prepared, which will be ground-truthed by field reconnaissance (as allowed by access). The preliminary area of ecological habitat identification and assessment is shown in Figure 2-8; additional areas may be added based on reconnaissance, or other RI activities (e.g., groundwater investigation).

Additionally, more detailed habitat surveys (including quantitative functional assessments, wildlife inventories, etc.) may be conducted during subsequent ecological risk investigations (e.g., Baseline Ecological Risk Assessment (BERA)), if necessary. The approaches for habitat identification/assessment are discussed below for three major ecosystem types: aquatic, wetlands, and upland areas.

2.5.2.1 Aquatic Habitats in the Brown Ditch System

Brown Ditch is a low-gradient, interconnected network of man-made channels extending into locally-significant interdunal wetlands. Brown Ditch was excavated in the early 1900s to drain and convey water from these wetland areas. Aquatic habitats in the Brown Ditch system consist of channels or ponded areas (including natural and man-made) supporting aquatic communities (e.g., fish and benthic macroinvertebrates). Initial identification of the Brown Ditch system will be based on USGS topographic maps, aerial photographs, and observations made during reconnaissance surveys conducted April 1, September 1, and October 21, 2004. For purposes of the RI/FS, the branched ditch systems are designated as follows (see Figure 1-2):

- West Branch (WB) for the ditch section located south and southeast of Yard 520;
- East Branch (EB) for the ditch section located east of Ardendale Avenue;

- South Branch (SB) for tributaries located south of the railroad corridor (i.e., South Railroad Avenue) which flow into the WB; and
- Main Branch (MB) for the combined flowage (WB, EB, SB) as it passes under Routes 20 and 12 and into the IDNL.

For further information regarding the Brown Ditch system, refer to the SMS (ENSR, 2005a) and Volume 6 of the RI/FS Work Plan, the ERA Work Plan.

2.5.2.2 Wetlands

Several wetland communities exist within the Area of Investigation, often in conjunction with the Brown Ditch system. As part of the initial habitat assessment, wetlands will be identified through inspection of the U.S. Fish & Wildlife Service (USFWS) 1987 National Wetlands Inventory Map (USFWS, 1987), aerial photographs, and/or reconnaissance activities. Wetland areas will be identified and mapped at a landscape scale (approximately 1 inch = 200 ft) based on these methods, without formal local delineation of boundaries of individual wetland units. Additional identification and investigation of wetland areas may be conducted in an additional phase of work following better understanding of the movement and flux of CCB-derived constituents in the saturated zone through the groundwater investigation.

2.5.2.3 Upland Areas

Upland ecological habitats within the area of ecological habitat assessment shown on Figure 2-8 will be identified as part of the investigation of the potential exposure of upland receptors to CCBs. To identify upland habitat, methods applicable for general habitat evaluation (non-wetland or mixed wetland/upland habitats), principally an integrated desktop/in-field assessment procedure based upon the methodology promulgated by the USFWS, will be used. The methods described in “A Techniques Manual for Measurement of Wildlife Habitat Parameters Used in the U.S. Fish and Wildlife Service’s Terrestrial Habitat Criteria Handbooks” (USFWS, 1979) provide general guidance for data collection and analysis of habitats.

Based on the information and resultant mapping, upland habitats will be mapped at a landscape scale (approximately 1 inch = 200 ft). Accompanying the habitat mapping figures, information will be provided to describe and summarize the following:

- Habitat types available;
- Area of contiguous habitat;
- Integrity of existing habitat;
- Current species observation and usage;

- Habitat impairment factors; and
- Contextual description of the local habitat relative to regional habitat.

Habitat maps will be developed based upon aerial photos and Geographic Information System (GIS) figures showing vegetative cover and specific habitat types with specific features (travel corridors, habitat suitable for breeding/nesting, forage areas, etc.) illustrated. These maps will be compared to areas of CCBs to identify areas of overlap and therefore areas of potential exposure.

2.5.2.4 Identification of Sensitive Receptors

Requests were made to USFWS and IDNR for information about Federal and State-listed endangered, threatened, or rare species, critical habitat, riparian area, and other sensitive natural resources (presented in the SMS (ENSR, 2005a)). The USFWS response letter dated March 16, 2004 indicated that the Area of Investigation is within the range of three Federally-listed species: Indiana bat (*Myotis sodalis*), bald eagle (*Haliaeetus leucocephalus*) and pitcher's (or dune) thistle (*Cirsium pitcheri*) (Pruitt, 2004). The IDNR response letter dated April 13, 2004 indicated that two state-listed plant species had been recorded to occur with the Area of Investigation, namely the Baltic rush (*Juncus balticus* var. littoralis) and Tower-mustard (*Arabis glabra*) (Neyer, 2004). These letters were provided in an appendix to the SMS (ENSR, 2005a). Information for Federal and State-listed species will be periodically checked during the course of SERA to ensure that other potentially relevant sensitive species will be identified and evaluated.

2.5.2.5 Background Reference Areas

Background reference areas refer to locations that are representative of regional conditions of climate, meteorology, geology and soils, land use, air deposition, and ecology. Media from these areas provide a useful benchmark for evaluation of conditions and concentrations, particularly for constituents with multiple sources, such as metals. These constituents are naturally present in many geologic materials and can be naturally present in groundwater as well. They can also be associated with other sources, such as road salt, septic systems, and/or municipal landfills. Concurrent with the field work to be conducted within the Area of Investigation, samples of surface water, sediments and soils will be collected and analyzed from background or reference stations (see Figures 2-1, 2-2, 2-6, and 2-7) as discussed in detail in other sections of this FSP.

2.6 Private Well Sampling

AOC II requires sampling of private wells to obtain additional information on potential exposures. Because of the uncertainties associated with the construction of private wells, sampling data from private wells may not meet data quality objectives for the RI. However, private well data may be used as screening-level data, for example, to guide other RI sampling activities. Where reliable well construction information is available for private wells (i.e., drillers records and/or IDNR database records which include screened intervals), the information will be included with the groundwater data from monitoring wells in the interpretation of groundwater conditions in the Area of Investigation.

Sampling methods for the private wells are presented in Section 3.0. Prior to sampling at each location, a formal well survey will be conducted. The well owner will be interviewed to obtain any available information about well location, depth, and construction, and information about the water distribution in the house so that an appropriate sample location can be selected.

The private well sampling will focus on areas that do not have municipal water service. The following private wells, pending homeowner approval, are proposed to be sampled. Locations are shown on Figure 2-9. This list includes all wells within the Area of Investigation for which well construction information exists in the IDNR database indicating they are screened in the surficial aquifer.

- <u>4190 West Dunes Highway</u> – This well is located north of Pine Street and Poplar Street. Previous sampling data in this area have not shown any exceedances of current USEPA RALs (see Figures 4 and 5 of the SMS (ENSR, 2005a)). This well has not previously been sampled. There is no known information about well construction.
- <u>4040 US Highway 20</u> – This well was previously sampled by IDEM and USEPA five times between September 2001 and September 2002. The IDNR database includes well construction information, which indicates that the well is screened in the surficial aquifer.
- <u>656 Railroad Avenue</u> – Of the three private wells along this street, this well has not previously been sampled. There is no known information about well construction.
- <u>554 and 572 South Railroad Avenue</u> – Of the six wells on the western end of South Railroad Avenue, two have not been previously sampled; both will be sampled as a part of the private well sampling program. There is no known well construction information at these two locations.
- <u>576 South Railroad Ave</u> – This well was previously sampled by USEPA in May 2002 and October 2003. The IDNR database includes well construction information, which indicates that the well is screened in the surficial aquifer.
- <u>1660 Ardendale (also known as 1660 N 625 E)</u> – This well was previously sampled by the USEPA in October 2003. Information in the IDNR database indicates the well is screened in a confined aquifer.
- <u>1690 Ardendale</u> - This well was previously sampled by USEPA in October 2003. The IDNR database includes well construction information, which indicates that the well is screened in the surficial aquifer.
- <u>1693 Ardendale</u> – This well was sampled by the USEPA in September 2003. Boron was detected above the current RAL. It will be re-sampled using the more extensive RI analyte

list to allow evaluation of potential sources of B. The IDNR database includes well construction information, which indicates that the well is screened in the surficial aquifer.

- 587 and 599 Old Chicago Rd (also known as 1600 North) – Both of these wells are located in the southern portion of the Area of Investigation. Available well construction information for 587 Old Chicago Road indicates the well is screened in the confined aquifer. These wells have not previously been sampled and will be sampled to evaluate conditions in the southern portion of the Area of Investigation, including the confined aquifer(s).

Each of these wells will be sampled over a one-year period, a total of four times (once each calendar quarter, see schedule in Section 4.0) to evaluate seasonal variability. Sampling will be conducted at the same time as groundwater samples are collected from monitoring wells.

Samples from the private wells will be analyzed for the selected parameters specified in Table 2-1.

As presented in the April 19, 2005 public meeting, the USEPA and USGS have successfully used boron-isotope ratio and tritium data to evaluate sources of boron. Therefore, each well will be sampled once for boron-isotope ratios and tritium.

2.7 Summary of Proposed RI Investigation

Figures 2-2 and 2-10 provide a summary of the sample locations proposed for the Pines Area of Investigation RI. The figures also show locations where samples have already been collected under the MWSE SAP (ENSR, 2004) and locations where samples will be collected under the Yard 520 SAP (ENSR, 2005b). The analytical program for the RI is summarized in Table 2-1.

2.8 Additional Investigations, if Necessary

At the completion of the work outlined in this FSP, it is possible that additional information may be needed to meet RI objectives. At this time, it is not possible to anticipate what additional work may be needed, as it is dependent on the results of the activities proposed. AOC II allows for a second phase of work. If needed, a memorandum documenting the need for additional data will be submitted to USEPA, per AOC II Section VIII. 32.

3.0 GENERAL FIELD PROCEDURES

This section of the FSP describes the procedures that will apply to the RI field program. Section 3.1 discusses the general management procedures that will be observed during the field program. Section 3.2 discusses the general field operations that will apply to the field program. Finally, Section 3.3 discusses the specific field investigation methodologies for the sampling activities outlined in Section 2.0.

3.1 Field Management Procedures

This section of the FSP describes the management procedures that will be followed for the field program. It describes the agreements and contracts that need to be in place prior to commencement of the field program, and procedures for security and control of the work location.

3.1.1 Access Agreements

Most of the land within the Area of Investigation is not owned by or under the control of the Respondents. Therefore, access agreements between the Respondents and individual property owners will be needed to access most sampling locations and install and/or use data collection equipment. Property owners will be approached regarding access. Where feasible, sample locations will be selected within public rights-of-way. It is expected that some sampling locations may need to be modified as a result of access issues.

3.1.2 Access, Control, and Security

A field office will be maintained on County Road 500 East on property owned by Brown Inc., which will serve as the central field office through the duration of the field work. The field office will provide office space, and space for equipment storage and sample handling. The field office will be locked or otherwise secured overnight and when un-manned to maintain security and custody control. The field office may be equipped with power, lights, heat, telephone, photocopier, fax machine, sanitary facilities, and a potable water supply. If any of these services are not available at the field office, they may be obtained as needed at the Brown Inc. facility, located at 720 West US Highway 20 in Michigan City.

The field team will consolidate and secure supplies and equipment in a vehicle or designated storage area prior to departure each day. The field team will conduct the work as much as possible such that all samples from any sampling point are collected during a single day in the field. Every effort will be made to complete work and remove all down-hole equipment (e.g., drilling augers) from the ground at the end of each day.

Most of the sample locations will be on private property not under control of the Respondents. Once sampling locations have been finalized and access agreements obtained (see Section 3.1.1), a list of property owners and contact information will be developed. Relevant property owners will be contacted prior to and at the completion of any work on their property unless they request otherwise. Every effort will be made to leave work areas tidy at the end of each day or as soon as possible thereafter.

Because much of the Area of Investigation is a residential area, there are likely to be pedestrians present in the vicinity of active work areas. For health and safety reasons, a clearly-marked exclusion zone will be set up around work areas in residential neighborhoods. Members of the public will not be allowed to enter the exclusion zone (for more detail, see the HASP, which is Volume 4 of this RI/FS Work Plan).

Additionally, the field team members will be identifiable by wearing photo identification badges and hard hats. The hard hats will be green in color and will have the label "Pines RI Investigation Personnel" affixed to the hard hats. The badges will include the following information:

- Photograph of the field team member;
- Name of the field team member;
- Company name of the field team member; and
- "Pines Area of Investigation, Remedial Investigation Personnel" labeled on the badge.

Members of the public will be notified about these identification methods in a newsletter prior to the commencement of the RI field activities.

3.2 General Field Operations

This section of the FSP describes general field activities and operations that apply to the field program. Pertinent Standard Operating Procedures (SOPs) are included in Appendix A of this FSP.

3.2.1 Field Team Responsibilities

The lines of authority and communication for this project are presented in the project organization chart (Figure 3-1). The responsibilities of key field personnel are outlined below.

ENSR RI Task Manager

The ENSR RI Task Manager, Elizabeth Perry, will have the overall responsibility for implementing the sampling activities described in this RI/FS Work Plan and for reporting these activities in the RI Report. Specific responsibilities of the ENSR RI Task Manager will include, but not be limited to, the following:

- Ensuring that ENSR's associates perform their designated duties in accordance with this FSP and the HASP (Volume 4 of this RI/FS Work Plan);
- Ensuring required QA/QC procedures are properly implemented and documented;
- Ensuring that sampling activities are completed within the approved schedule;
- Communicating any request for modifications to the approved FSP to the ENSR Project Manager and USEPA as appropriate; and
- Promptly notifying the ENSR Project Manager if unforeseen field conditions and/or analytical issues are encountered that affect achievement of the project DQOs.

Ms. Perry is also a Professional Geologist licensed to practice in Indiana. All geologic-related work (e.g., logging, well installation) will be performed under her direction. While she may not be in the field directly conducting the work, she will review and approve all such work.

ENSR Field Operations Leader

The Field Operations Leader for the Pines Area of Investigation will be responsible for implementing sampling activities according to the RI/FS Work Plan and under the direction of the RI Task Manager. Other responsibilities may include gathering and analyzing data, and preparing pertinent sections of the RI Report. The Field Operations Leader will report directly to the ENSR RI Task Manager.

ENSR Field Technical Staff

The Field Technical Staff will be responsible for implementing sampling activities according to this FSP. Other responsibilities may include gathering and analyzing data, and preparing various task reports. The field technical staff will report directly to the ENSR Field Operations Leader.

ENSR Field Health and Safety Coordinator (HSC)

The HSC is responsible for enforcing the requirements of the HASP once field work begins. By design, the HSC has the authority to immediately correct all situations where noncompliance with the HASP is noted and to immediately stop work in cases where an immediate danger is perceived. Some of the HSC's specific responsibilities include:

- Procuring and distributing the Personal Protective Equipment (PPE) needed for field activities;
- Procuring the air monitoring instrumentation required and performing air monitoring;
- Verifying that all PPE and health and safety equipment is in good working order;
- Setting up and maintaining the personnel decontamination facility;
- Notifying the ENSR Project Manager and the ENSR Regional Health and Safety Manager of all noncompliance situations and immediate danger situations;
- Assuring changes to the HASP are approved by the ENSR Regional Health and Safety Manager;
- Supervising and monitoring the safety performance of all personnel to ensure that required safety and health procedures are followed, and correcting any deficiencies;
- Conducting accident/incident investigations and preparing accident/incident investigation reports; and
- Initiating emergency response procedures.

3.2.2 Field Changes

Procedural changes in the field may be needed when the sample network is changed or when sampling procedures and/or field analytical procedures require modification due to unexpected conditions. The ENSR field staff in consultation with the ENSR RI Task Manager and ENSR Project QA Officer will recommend the change. The ENSR RI Task Manager in consultation with the USEPA will approve the change, which will be implemented by the ENSR field staff. It will be the responsibility of the ENSR RI Task Manager and the ENSR Project Manager to ensure that corrective action has been implemented. Field changes may be initiated by personnel in the field based on unexpected conditions.

If the field change will supplement the existing sampling plan using existing and approved procedures in this FSP, changes approved by the ENSR RI Task Manager will be documented. If field changes result in fewer samples, alternate locations, etc., which may cause project DQOs not to be achieved, it may be necessary that all levels of project management be notified.

Field changes will be implemented and documented in the field logbook. Field changes will also be documented on a field change order (FCO) form according to ENSR SOP No. 100Pines – Field Change Order Procedures (see Appendix A). No staff member will implement field changes without prior communication of findings through the proper channels.

3.2.3 Field Documentation and Chain-of-Custody

All field activities will be documented using various forms and/or a field logbook.

3.2.3.1 Field Records

Field logbooks will provide the primary means of recording the data collecting activities performed during implementation of the RI. As such, entries will be described in as much detail as possible so that persons going to the field could reconstruct a particular situation without reliance on memory.

Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in the project files when not in use. Each logbook will be identified by a project-specific document number.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, and the signature of the person making the entry will be entered. The names of visitors to the work location, and the purpose of their visit, will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in permanent ink, signed and dated, and no erasures or obliterations will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark and the correct entry will be made, signed and dated by the person making the correction. Whenever a sample is collected, or a measurement is made, a detailed description of the sampling location, which may include compass and distance measurements, or latitude and longitude information (e.g., obtained by using Global Positioning System (GPS)) will be recorded. All equipment used to make measurements will be identified, along with the date of equipment calibration. The coordinate system that the GPS unit displays will be recorded. The units used by other recording equipment will also be documented.

Information specific to sample collection will include:

- Sample identification number;
- Time and date of sample collection;
- Sample description (medium, color, texture, etc.);
- Purging procedures;
- Field parameters (specific conductance, pH, etc.);
- Depth of sample interval (bgs or below the water surface);

- Sample type; and
- Location (e.g., GPS coordinates and description).

To streamline data recording, information will be recorded on standardized forms when this approach is logical. Examples of several forms are included in the SOPs in Appendix A.

Descriptions of geologic materials and CCBs will be logged in accordance with Indiana guidance (IDEM, 1988; see Appendix A).

Where photographs are taken, a digital camera will be used, and the camera picture frame number, date, direction facing, and subject will be recorded in the logbook.

A copy of the chain-of-custody (COC) forms will be maintained as part of the field records as described in Section 3.2.3.3, and ENSR SOP No. 1007Pines – Chain-of-Custody Procedures (see Appendix A).

3.2.3.2 Sample Labeling

Immediately upon collection, an adhesive sample label will be affixed to each container, including the unique sample identification (ID) (as described below), the time and date of sample collection, the sampler's initials, parameters to be analyzed, and preservation, if applicable. The project name will not be shown on the label. The unique sample identification will be an alphanumeric code consisting of the following elements:

- Name of sampling location in five digits (e.g., SS002, etc.). These location names will correspond to logs of the geologic materials, as well as sample locations posted on maps. Location names will be reviewed with the RI Task Manager prior to initiating field work.
- Single letter signifying depth of sample (A, B, C, etc. for samples taken at increasing depth, X if this field is not being used). The actual depth measured in the field in feet will be recorded in the field records.
- Two letters signifying the sample matrix (CB for suspected CCBs, GW for groundwater, PW for samples from private wells, SB for subsurface soil, SS for surface soil (0 to 6-in depth), SW for surface water, SD for sediment).
- Sampling date consisting of the number corresponding to the month (2 digits), day (2 digits) and year (2 digits), for example, 061404 for samples collected on June 14, 2004.
- Letter denoting the type of sample. Codes for this field include: S – sample; D – field duplicate; B – equipment rinsate blank.
- Letter (F) denoting that an aqueous sample has been filtered.

No dashes will be used to separate fields. An example sample ID would be: SS001XSS101104D indicating a surface soil sample collected at location SS001 on October 11, 2004. This sample is a field duplicate, and the X represents the depth, which is not being used since only one sample is being collected from that location. The actual depth will be recorded in the field logbook.

Samples designated as matrix spike/matrix spike duplicates (MS/MSDs) will be noted as such in the comments field of the COC form.

The sample identification code will be recorded on the label, in the field logbook and other field forms, on the COC form, and will be carried through the analytical process to reporting.

3.2.3.3 Sample Custody

The field sampler(s) are responsible for the care and custody of the samples including shipping to the laboratory. As few people as possible will handle the samples. Field samplers will complete the COC in accordance with ENSR SOP No. 1007Pines – Chain-of-Custody Procedures (see Appendix A).

3.2.3.4 Sample Packaging and Shipping

Samples will be packaged for shipment to the laboratory under the COC procedures described in ENSR SOP No. 1007Pines – Chain-of-Custody Procedures and ENSR SOP No. 7510Pines – Packaging and Shipment of Environmental Samples (See Appendix A).

After sample containers are labeled and filled, samples may be placed in plastic zipper-lock bags to contain material in the event of container spillage during shipment. Containers will then be packaged in a cooler for shipment, using inert packing material (e.g., bubble wrap, rubber foam, or equivalent) to prevent breakage during shipment. The cooler will be packed with sufficient ice to maintain cool temperatures for overnight delivery. A multi-form COC form will be completed (an example COC form is presented in Appendix A). The original COC will be placed in a zipper-lock bag that is taped to the lid inside each cooler of samples being submitted to the laboratory for analyses. The back copy of the COC will be maintained with the field records. The cooler will be locked or sealed, and custody seals placed on the outside of the cooler in such a way that the cooler cannot be opened without breaking the seals.

Sampling, analytical holding times, and shipping and receiving of samples will require close attention and coordination between field staff and laboratory staff. During the time period between collection and shipment, samples will be stored in ice-filled coolers or refrigerated, if applicable, and maintained under sample custody. Samples will be shipped to the laboratory via commercial overnight courier (e.g., Federal Express).

3.2.4 Project Files

The project file will be the central repository for all documents relevant to sampling and analysis activities as described in this FSP. The management of documents and records pertaining to the overall RI/FS will be in accordance with the QMP (Volume 7 of this RI/FS Work Plan).

The project files for the RI will include at a minimum:

- Plans;
- Field logbooks;
- Field forms;
- Photographs;
- Drawings;
- Laboratory data deliverables;
- Progress reports, QA reports, interim project reports, etc.; and
- All custody documentation (forms, airbills, etc.).

Records associated with this sampling will be retained with all the project records for the duration of AOC II and for a minimum of 10 years after its termination. USEPA, NIPSCO and Brown Inc. will be notified in writing 90 days prior to destruction of the records (per AOC II Section XIII. 44.).

3.2.5 Mobilization/Demobilization

Mobilization includes equipment procurement and transport to the field office and/or specific work location, subcontractor coordination, utility awareness and clearance, and setup of decontamination and waste storage areas. Equipment requirements will be finalized by the RI Task Manager following acceptance of this FSP. The RI Task Manager will review the scope of work and assemble equipment to implement the complete field investigation. Finally, the RI Task Manager, or their designee, will be responsible for packaging and loading equipment, and ensuring that all equipment is operable and calibrated. The field office will serve as a temporary storage area for equipment.

Analytical laboratory services will be subcontracted. Following the procurement of these services, the RI Task Manager or designee will be responsible for coordinating the analytical services, as well as the acquisition and delivery of sample bottles to the Area of Investigation. Other subcontractors include drillers, Geoprobe®/HydroPunch® contractors, and surveyors.

Utility clearances will be coordinated by the ENSR Field Operations Leader with appropriate subcontractors (see Section 3.3.1).

Demobilization will involve the decontamination of equipment and removal from the work location once field activities have been completed. All wastes will be properly managed as discussed in Section 3.2.7 below.

3.2.6 Decontamination

Appropriate decontamination procedures will be used for health and safety reasons and to minimize the potential for cross-contamination.

3.2.6.1 Sampling Equipment

Sampling equipment (e.g., water level indicators, pumps, split-spoons, etc.) will be decontaminated prior to sampling and between samples, in accordance with ENSR SOP No. 7600Pines – Decontamination of Field Equipment (see Appendix A). In general, equipment used will be decontaminated using the following procedure:

- Tap water rinse to remove gross contamination;
- Non-phosphate, non-borate detergent (e.g., DETERGENT8®) and water rinse;
- Tap water rinse;
- Distilled/deionized water rinse;
- 10% nitric acid rinse;
- Distilled/deionized water rinse; and
- Air dry or wrap in aluminum foil for later use.

Water generated during decontamination of sampling equipment will be handled as described in Section 3.2.7.

If sample collection tools include dedicated or disposable equipment, then no decontamination will be performed for these items.

3.2.6.2 Personnel

Personnel decontamination is detailed in the HASP (Volume 4 of this RI/FS Work Plan).

3.2.6.3 Heavy Equipment

All heavy equipment, including the drilling rig, rods and augers, and other downhole equipment used during the investigation, will be decontaminated prior to beginning work and between all boreholes or locations (including between wells within a cluster) using a high-pressure steam wash. The water to be used during steam-cleaning will be from a potable source. All heavy equipment will be decontaminated in accordance with the ENSR SOP No. 7600Pines – Decontamination of Field Equipment (see Appendix A).

3.2.7 Investigation Derived Waste (IDW) Management

Investigation-derived waste (IDW) for the field investigation program will be managed in accordance applicable USEPA and IDEM regulations. It is anticipated that IDW materials will be generated during the field investigation. These materials may include:

- Decontamination fluids;
- Used PPE;
- Used sampling equipment;
- Excess soil/CCB material, such as drill cuttings; and
- Well purge water.

These wastes will be handled in the following manner:

- Visibly clear, non-phosphate and non-borate detergent wash water and rinse water decontamination fluids from sampling equipment will be released to the ground, in the immediate vicinity of its point of generation. If warranted, based on its condition or the sample location, the decontamination rinse water will be contained in 55-gallon drums or bulk containers and staged at the designated IDW staging area.
- Used PPE, such as sampling gloves, paper towels, or other materials will be bagged and sealed prior to disposal as general refuse.
- Used disposable sampling equipment, such as trowels and empty bottles, will be disposed of with the PPE as general refuse.
- Drill cuttings and excess split-spoon soil samples that visibly contain suspected CCB materials will be contained in 55-gallon drums and staged at the designated IDW area. All other cuttings and excess samples will be placed back down the borehole or spread on the ground in the immediate vicinity of the borehole where generated. The drums will be clearly marked with a label or with a grease pencil or other water-resistant marker to indicate the

date and the location from which the cuttings were removed. The words “CCB/SOIL” will be used to denote these materials as solids. The drums will be staged in an orderly fashion, with proper spacing, in a designated area. After the analytical data from the sampling program has been received and evaluated, a determination will be made as to the proper disposal method. If analytical results are below the values used by IDEM for management of IDW (IDEM, 2004), the soils may be left on site. If off-site disposal is required, additional sampling (if required), transportation, and disposal at a licensed receiving facility will be arranged.

- Water generated during well development and purging of the wells prior to and during groundwater sampling will be collected and transferred for staging in 55-gallon drums. The water will be staged with the other IDW pending receipt of analytical results. The drums will be clearly marked similarly to the drummed soil cuttings, except with the word “WATER”. After the analytical data from the groundwater sampling program have been received and evaluated, a determination will be made as to the proper disposal method for the contained water. If analytical results are below the values used by IDEM for management of IDW (IDEM, 2004), the drummed water may be discharged to the ground. If off-site disposal is required, additional sampling (if required), transportation, and disposal at a licensed receiving facility will be arranged.

The ENSR team will be responsible for arranging the removal and proper disposal of all accumulated waste materials. Disposal will be arranged with licensed waste haulers at approved receiving facilities.

3.2.8 Professional Land Surveying

The coordinates of all monitoring wells, staff gauges, and piezometers will be surveyed by an Indiana registered surveyor. The coordinates of the features will be surveyed for incorporation into the GIS and database for the project.

Surveying will establish the horizontal and vertical coordinates of monitoring wells, piezometers, and surface water level monitoring locations. All monitoring points will be surveyed for the following:

- Horizontal (x and y) coordinates to an accuracy of 0.1 ft;
- Elevation of the mark (or notch) at the top of the well riser or other structure to an accuracy of 0.01 ft; and
- Elevation of ground surface to an accuracy of 0.1 ft.

All horizontal measurements will be in Indiana State Plane coordinates, using 1983 North American Datum (NAD83), feet. All vertical measurements will be surveyed in 1988 USGS National Geodetic Vertical Datum (NGVD) coordinates. At staff gauges, the elevations of both the top of the gauge and the zero point on the gauge (if present) will be surveyed.

3.2.9 Surveying by GPS

Where sufficient accuracy may be achieved by field personnel, a GPS unit may be used to determine the locations of objects of interest (e.g., limits of CCBs, HydroPunch®, surface water, and sediment locations, etc.).

A Trimble GPS Pathfinder Pro XRS® (or similar) unit will be utilized to obtain horizontal measurements with an accuracy of +/-0.5 meters. At the beginning and end of each day, GPS measurements will be collected from a reference point. This reference point will be the same location for each day that the GPS unit is being used. The collection of data from the reference point will allow for comparison in accuracy of the data collected.

A data dictionary defining the parameters to collect the data will be pre-defined prior to the collection of any data. Default parameters will be used, as they are set to meet the criteria for optimum data collection. However, the following parameters will be checked prior to data collection:

- Satellite Vehicles (SVs) – A minimum of 3 SVs are necessary to obtain latitude and longitude positions. The default value is set at 3 SVs; however, during data collection all available SVs will be used.

- Position Dilution of Precision (PDOP) – The default value for PDOP is 6. PDOP values below 6 are required for submeter accuracy on the ProXRS GPS unit. This default value of 6 will prevent positions from being collected if the PDOP is greater than or equal to 6. Data collection will resume once the PDOP drops below 6.

- Signal to Noise Ratio (SNR) – SNR, or signal strength, has a range from zero to 35. The default value for SNR is 6; however, values greater than 20 are optimum but may not be achievable. Data will not be collected if the SNR is less than or equal to 6.

- Logging Interval – For point features, a minimum of 5 seconds (2 positions per second) is recommended for each data point collection. For line features, a minimum of 5 seconds is required for data collection.

GPS positions will be collected in World Geodetic System (WGS), 1984 during data collection. After data has been collected, the data will be downloaded and converted to the site coordinate system. All associated attribute data used for data collection will be downloaded with the coordinate information. The data will then be added to the site database.

3.3 Field Investigation Methodologies

This section describes the procedures and requirements associated with the specific field activities discussed in Section 2.0.

3.3.1 Utility Clearance

Clearance of utilities located in the work area is necessary prior to performing subsurface field activities. Utilities may include municipal water, electricity, cable television, telephone, gas, and storm sewer. At least two full working days, but no more than 20 calendar days prior to the start of intrusive field work, the field staff will contact the Indiana Underground Plant Protection Service Inc. (IUPPS):

IUPPS
Indiana Underground Plant Protection Service Inc.
1-800-382-5544
www.iupps.org

The field staff will provide IUPPS with the county and the township as well as a street address and cross street of the locations necessary for utility clearance. Where possible, the field staff will mark areas where field work may affect any subsurface utilities with white marking paint or white flags (where paint is not applicable) prior to calling IUPPS. Marking areas with white paint/flags will guide IUPPS on where to concentrate their locating efforts.

IUPPS underground facility members will mark or otherwise identify facilities according to the following color codes in accordance with Damage to Underground Facilities, Indiana Code 8-1-26-18:

Utility	Marking Color
Electric power distribution and transmission	Safety Red
Municipal electric systems	Safety Red
Gas distribution and transmission	High Visibility Safety Yellow
Oil distribution and transmission	High Visibility Safety Yellow
Dangerous materials, product lines & steam lines	High Visibility Safety Yellow
Telephone and telegraph systems	Safety Alert Orange
Cable television	Safety Alert Orange
Police and fire communications	Safety Alert Orange
Water systems	Safety Precaution Blue
Sewer systems	Safety Green
Proposed construction	White

Additional information on contacting and providing the necessary information can be found on the IUPPS website at www.iupps.org.

Where subsurface work takes place on private property, field staff will work with the property owner to supplement the IUPPS information where possible.

3.3.2 Visual Inspections for CCBs

Information about potential locations of CCBs in the Area of Investigation is compiled in the SMS (ENSR, 2005a) and presented here on Figure 2-3. Some of this information has been field checked during installation of the municipal water service in 2004 (see, for example, the sample locations in Figure 2-1). As part of the RI, all available information will be tabulated to summarize what is known or suspected about the presence and description of the suspected CCBs outside Yard 520. A visual inspection program will then be used to field verify the information.

As described in the preliminary CSM (presented in the SMS (ENSR, 2005a)), the native soils in the Area of Investigation are typically white to tan sands in uplands and fine-grained organic soils in the lowlands. It is anticipated that fill materials, including but not limited to suspected CCBs, will have a distinctly different appearance in the field. The suspected CCBs in the water service utility trenches are black and clearly different than the native soils.

To confirm the presence of suspected CCBs in the Area of Investigation, a field reconnaissance will be performed to verify the potential locations of suspected CCBs shown on Figure 2-3. The reconnaissance will include field verification of potential suspected CCB locations by observations at the ground surface. Where grass or topsoil may limit inspection of the soil surface, a shovel may be used to dig beneath the surface layer to visually inspect the surface soils for the presence of suspected CCBs. The material encountered (both native soils and suspected CCBs) will be noted in the field logbook. After the material description has been noted, the disturbed material will be placed back into the ground and the surface restored.

A systematic approach will be used for conducting the inspections and defining boundaries of the suspected CCB areas. The inspections will initially be conducted along roadways, where most of the suspected CCBs have been reported. After access agreements are obtained, inspections laterally away from roadways will be conducted. The inspections will be conducted as follows:

- The rights-of-way and shoulders on both sides of all roads within the Area of Investigation will be inspected. Where suspected CCBs are not visible at the ground surface, a shovel will be used to inspect below the surface layer at a minimum frequency of every 50 feet.
- Where suspected CCBs are observed along roadways within the Area of Investigation, inspections will be expanded laterally away from the roads. Once access agreements have been obtained, inspections will be conducted along lateral transects perpendicular to the road every 400 feet. Along these laterals, where suspected CCBs are not visible at the ground surface, a shovel will be used to inspect below the surface layer at a minimum frequency of every 50 feet.
- In addition, similar inspections will take place within the Area of Investigation where information suggests suspected CCBs may have been used as fill on private property.

All observations will be recorded in the field logbook. The coordinates defining the limits of suspected CCBs will be recorded using a handheld GPS unit (see Section 3.2.9).

3.3.3 Habitat Evaluation

General ecological habitats will be identified from a combination of maps, aerial photographs, previous surveys and inventories (including those provided by National Park Service (Hicks, 2004)), and other available literature sources. Based on this information, a preliminary ecological habitat map will be prepared, which will be ground-truthed by field reconnaissance (when access is obtained).

To identify habitat, methods applicable for general habitat evaluation (non-wetland or mixed wetland/upland habitats) will be used, principally an integrated desktop/in-field assessment procedure based upon the methodology promulgated by the USFWS. The methods described in “A Techniques Manual for Measurement of Wildlife Habitat Parameters Used in the U.S. Fish and Wildlife Service’s Terrestrial Habitat Criteria Handbooks” (USFWS, 1979) provide general guidance and methods for collection and analysis of habitats. Relative to general assessment, this methodology will include the following procedures:

- Analysis of aerial photographs, USFWS or USGS maps, and regional wildlife records to determine likely species;
- In-field observations of important habitat parameters, including:

- – Vegetative characteristics (percent ground cover and effective ground cover, and region-specific indicator species);
- – Slope, aspect, and topography throughout the area of analysis and adjacent areas;
- – Habitat type interspersion and habitat edge feature analysis;
- – Distance to roads and human settlements; and
- – Specific habitat feature analysis (brushpiles, snags, den trees, standing dead timber, mast- and fruit-producer abundance, herbaceous or cereal vegetation).

- Analysis of sign, including tracks and scat, burrows, claw marks on vegetations, rubs and scrapes, spawning activity;
- Analysis of habitat feature requirements for specific species as required (e.g., perch types, substrate type and depth, etc.); and
- Spatial analysis through GIS plan production or aerial photo overlays for graphical habitat characterization and analysis.

Based on the information, upland habitats will be mapped at a landscape scale (approximately 1 inch = 200 ft). Accompanying the habitat mapping figures, information will be provided to describe and summarize the following:

- Habitat types available;
- Area of contiguous habitat;
- Integrity of existing habitat;
- Current species observation and usage;
- Habitat impairment factors; and
- Contextual description of the local habitat relative to regional habitat.

3.3.4 Private Well Sampling

The private wells will be sampled by collecting a water sample from a location at the house as close to the wellhead as possible for laboratory analysis. The appropriate bottleware for each analysis will simply be filled from the first accessible location within the household. Sample collection will be conducted by sampling as close to the wellhead as possible (i.e., before any treatment or distribution), and the water will be allowed to run for 15 minutes prior to sample collection to purge the system of stagnant water. If the first accessible point for sampling is located after a treatment system (i.e., treated water), then no sample will be collected. Specific procedures for private well sampling are provided in ENSR SOP No. 106Pines – Private Well Sampling (See Appendix A).

Sample documentation, labeling, custody, packaging and shipping procedures will follow the methods as described in Section 3.2.3. The address of the well location will be documented in the field logbook.

3.3.5 Drilling and Direct-Push Methods

In general, drilling will be conducted at the Area of Investigation for the following objectives:

- Characterize overburden geologic conditions;
- Collect subsurface soil samples (e.g., Yard 520 SAP); and/or
- Install overburden groundwater monitoring wells.

Soil borings for geologic description and soil sample collection may use conventional drilling methods or direct-push methods (e.g., Geoprobe®). It is anticipated that soil borings will generally be drilled under this FSP using conventional hollow-stem augers with split spoon sampling in accordance with ENSR SOP No. 109Pines - Split Spoon Sampling for Geologic Logging (Appendix A).

Drilling for well installations will be conducted using a conventional truck-mounted, 6-inch inside-diameter hollow-stem auger drilling rig operated by a drilling subcontractor licensed by the state of Indiana. The use of an all-terrain vehicle (ATV) mounted drilling rig will be considered for locations with limited truck access.

During drilling for well installation, continuous split spoon samples will be collected from each boring until the top of the confining clay unit is encountered. Borings will typically extend to the clay confining unit approximately four feet (two split-spoon lengths) to confirm the top of the clay. Use of continuous split-spoon sampling may be modified based on field conditions, such as poor recovery or running sands (see ENSR SOP No. 109Pines). The split-spoon samples will be used to prepare a geologic log as described in Section 3.3.6 and ENSR SOP No. 109Pines – Split Spoon Sampling for Geologic Logging. Monitoring wells will be installed as described in Section 3.3.7 below. Subsurface soil samples will also be collected under the Yard 520 SAP (ENSR, 2005b). Specific procedures are described in that sampling plan. Additional subsurface soil samples will be conducted using direct-push techniques as described in ENSR SOP No. 7116Pines – Subsurface Soil Sampling by Geoprobe® Methods.

All downhole drilling equipment will be steam-cleaned before use at each boring following procedures described in ENSR SOP No. 7600Pines – Decontamination of Field Equipment (see Appendix A).

Drill cuttings and split spoon materials will be handled as IDW as described in Section 3.2.7.

3.3.6 Geologic Classification and Description

Geologic materials encountered at sample locations and in boreholes will be logged in accordance with the Unified Soil Classification System (USCS) protocols (see, for example, AGI, 1982 or USEPA, 1991). Geologic descriptions will be entered on a well or boring log, an example of which is included in ENSR SOP No. 109Pines – Split Spoon Sampling for Geologic Logging. Specific information to be recorded on the log includes location identification and/or description, drilling subcontractor, geologist name, drilling date, drilling equipment, split-spoon sample interval, blow counts, and total depth of boring. Geologic information includes: moisture content, color, grain-size, sorting, density, plasticity and any other relevant observations. In accordance with IDEM guidance (IDEM, 1988), additional information will also be recorded, such as U.S. Department of Agriculture (USDA) soil classification, rounding, effervescence, mineralogy, and bedding. The IDEM guidance and other supporting information is provided in the SOP in Appendix A.

3.3.7 Construction of Monitoring Wells

Monitoring wells will be installed in the surficial aquifer and constructed of 2-inch diameter PVC piping. If the surficial aquifer is less than 5 feet in saturated thickness, the well will either be re-located or not installed if field conditions do not permit for another appropriate location. The only location where this may be an issue is location R (see Figure 2-4), which is located where the surficial aquifer is believed to pinch out. This well is intended as a background location. If the aquifer is thin, it will not provide a representative characterization of background. Monitoring wells will not be installed in the confined aquifer. Detailed procedures for well installation are provided in ENSR SOP No. 7220Pines – Monitoring Well Construction and Installation (Appendix A).

Monitoring wells will be constructed using 2-inch inside-diameter, schedule 40 PVC with threaded joints. The screen will be a 0.010-inch factory-slotted PVC. For wells screened at the water table, 15 feet of screen will be used, with approximately 10 feet of screen set below and 5 feet of screen above the water table. For wells screened below the water table, 10 feet of screen will be used (and set entirely below the water table). Wells will generally be installed with the screen at the water table. However, the results of the vertical profiling (Section 2.4.2) will be used to select appropriate screened intervals. The vertical profiling may also suggest whether well pairs may be appropriate in certain locations, for example, if there are significant differences between concentrations in shallow and deep samples.

If the borehole extends beyond the bottom of the selected screened interval, clean silica sand will typically be used to backfill the hole until the bottom of the screened interval is reached. Where the surrounding material is clay, bentonite pellets or chips will be used to fill the borehole to a minimum depth of 1 foot below the bottom of the well screen. The space between the bentonite/grout and the bottom of the screen will be filled with sand.

A clean silica sand pack sized appropriately for the screen will be placed around the well screen to a height of approximately two feet above the top of the screen. A two-foot bentonite seal will be placed on top of the sand pack. The remainder of the well annulus will be grouted to the land surface using a cement-bentonite grout mixture. Monitoring wells located in areas of traffic will have flush-mounted road boxes, while wells located in other areas will have steel protective stand up casing. A 2-foot by 2-foot cement apron will be installed to hold the protective casing (i.e., road boxes or stand up casing) in place. This apron will be mounded at the ground surface to direct surface water runoff away from the well. All new monitoring wells will include a locking well cap with locks that are keyed alike.

After the wells have been installed, either a mark in permanent black ink or a notch will be made in the highest point of the PVC riser. This will serve as the location at which the well elevation will be surveyed as well as the location from which water level measurements will be taken.

All field notes will be recorded on field log sheets and/or the field log book.

3.3.8 Well Development

All new wells will be developed following installation and prior to sampling. Proper well development is necessary to:

- Remove silts and fine material from the well and filter pack;
- Establish good hydraulic connection with the formation;
- Restore the permeability of the formation; and
- Ensure collection of representative samples of groundwater.

Development procedures for wells will include surging the well with a surge block and periodically removing water from the well via pumping or bailing, depending on the well's recharge capacity. Well development will continue until the purge water is visually free of silt, preferably with turbidity readings less than 50 Nephelometric Turbidity Units (NTU). Development will be discontinued if the water does not clear after 4 hours, and this condition will be noted in the field logbook. Monitoring wells will be allowed to re-equilibrate for at least 2 weeks after development prior to well sampling.

All field notes will be recorded on field log sheets and/or field log books. Specific procedures on conducting well development activities are provided in ENSR SOP No. 7221Pines – Monitoring Well Development (see Appendix A).

All down-well equipment used in well development will be decontaminated following procedures outlined in Section 3.2.6 and ENSR SOP No. 7600Pines – Decontamination of Field Equipment (see Appendix A).

Water and sediments removed from the well during development will be managed as IDW, as described in Section 3.2.7.

3.3.9 Water Level Measurements

Water level measurements will be recorded to support hydrogeologic characterization. Groundwater levels may also be measured in wells immediately prior to purging and sampling. All measurements will be collected and recorded in accordance with ENSR SOP No. 101Pines – Water Level Measurements (see Appendix A).

Water level measurements at wells and piezometers will be obtained with an electronic water level indicator. This indicator has a weighted cord, which is accurate to 0.01 feet. The depth to water in the well will be measured from surveyed elevation mark on the PVC riser (either the black mark or notch, see Section 3.3.7 above).

At staff gauges, surface water levels may be measured from the top of the gauge or other fixed structure (e.g., bridge) using an electronic water level indicator. At stadia-marked gauges, the level of the water will be read directly off the gauge. The type of gauge and type of measurement will be recorded in the field logbook.

The electronic water level indicator will be decontaminated between monitoring locations to prevent cross-contamination following procedures outlined in ENSR SOP No. 7600Pines – Decontamination of Field Equipment (see Appendix A).

3.3.10 Groundwater Purging and Sampling

All groundwater samples will be collected using low stress (low-flow) purging and sampling procedures according to the USEPA Region I SOP titled "Low Stress Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells", Revision 2, July 1996 (USEPA, 1996) and IDEM Office of Land Quality (OLQ) Geological Services Technical Memorandum titled "Micro-Purge Sampling for Monitoring Wells" dated January 8, 2003 (IDEM, 2003) (see Appendix A). The low-flow method emphasizes the need to minimize water level drawdown using low groundwater pumping rates to collect samples with minimal alterations to groundwater chemistry. Specific procedures for groundwater sampling are presented in ENSR SOP No. 7130Pines – Groundwater Sample Collection from Monitoring Wells.

Peristaltic pumps will typically be used for purging and sampling. Where water levels are too deep for operation of a peristaltic pump, submersible Grundfos Redi-Flo2 pumps will be used. As appropriate, dedicated or disposable polyethylene tubing will be used for each monitoring well in order to minimize cross-contamination and decontamination.

The pump intake will be set at the midpoint of the saturated screen and at least 2 feet above the bottom of the well to preclude excess turbidity from the bottom of the well.

During well purging, the water level will be measured with a water level indicator. Water level drawdown and flow rate will be recorded on groundwater collection forms. A final purging rate will be selected that does not exceed 0.5 L/min (typically between 0.1 L/min and 0.3 L/min), and results in a stable drawdown, ideally less than 0.3 ft.

Groundwater will be pumped though a flow-through cell, and the following parameters will be measured: pH, specific conductivity, temperature, DO, and ORP. These parameters will be measured with a water quality meter, calibrated according to the manufacturer's specifications as described in ENSR SOP No. 105Pines – Operation and Calibration of the YSI Multi-Parameter Water Quality Monitor. Turbidity will be measured separately with a turbidity meter (ENSR SOP No. 108Pines – Field Measurement of Turbidity, see Appendix A). A round of parameter measurements will be recorded after the flow cell is full, approximately 10 minutes after the flow cell is full, and then approximately every 5 minutes thereafter, until parameter values have stabilized.

Purging is considered complete and sampling may begin when all parameter values have stabilized and turbidity is below 5 NTU. Stabilization is considered to be achieved when three consecutive readings, taken at 3- to 5-minute intervals, are within the following limits:

- Turbidity : less than 5 NTU or ± 10%
- DO : ± 10%
- Specific Conductance : ± 3%
- Temperature : ± 3%
- pH : ± 0.1 standard units
- ORP : ± 10 millivolts

Every effort will be made to lower the turbidity to less than 5 NTU before sampling. If the turbidity cannot be reduced to below 5 NTU, the pumping rate will be reduced. If turbidity still cannot be reduced below 5 NTU, samples may be collected if all other parameters are stable and the turbidity is stable. The condition will be noted in the logbook.

If low-flow purging cannot be achieved for a particular well (typically due to insufficient yield to establish a stable drawdown), the well may be purged dry, then sampled when sufficient water has recharged. The condition will be noted in the logbook.

Immediately following purging, the flow-through cell will be disconnected and groundwater samples will be collected and placed into their sample containers. Required bottleware is presented on Table 3-1. Groundwater samples will be collected using the same equipment and the same pumping rate as during purging. Samples will be preserved as necessary (see Table 3-1) and placed on ice.

Low-flow purging results in less stress to the aquifer, and therefore, filtering samples for metals analysis is typically not required. However, if any samples are to be filtered (e.g., due to elevated turbidity), they will be filtered in the field at the wellhead using a 0.45-micron, in-line filter as detailed in ENSR SOP No 7131Pines – Field Filtration of Water Samples for Inorganic Constituents (Appendix A).

All measurements will be recorded in accordance with ENSR SOP No. 7130Pines – Groundwater Sample Collection from Monitoring Wells (see Appendix A). Sample documentation, labeling, custody, packaging and shipping procedures will follow the methods as described in Section 3.2.3. Analytical hold times are provided in Table 3-1.

Equipment (e.g., pumps) used for sampling will be decontaminated between sampling points as described in Section 3.2.6 and in accordance with ENSR SOP No. 7600Pines – Decontamination of Field Equipment (see Appendix A).

The groundwater removed from the well during purging will be managed as IDW, as described in Section 3.2.7.

3.3.11 In-Situ Hydraulic Conductivity Testing

Slug testing will be used to estimate aquifer hydraulic conductivity. Specific procedures are provided in ENSR SOP No. 102Pines – In-situ Hydraulic Conductivity Testing, Rising and Falling Head Permeability Tests (see Appendix A).

Prior to initiation of slug testing at each well, the water level will be measured to the nearest 0.01 foot using an electronic water level meter (see Section 3.3.9). An electronic water level/pressure transducer will then be lowered into the well and connected to data logging equipment. The transducer will have an accuracy of at least 0.01 feet. The data logger will be set up in accordance with manufacturer's instructions and site-specific conditions. After the static water level has been re-established, a decontaminated PVC slug (of known diameter and length) will be lowered into the well just above the water table.

Both rising head and falling head slug tests will be performed, to the extent possible for each given well configuration:

- For monitoring wells with screens entirely below the water table, the slug will be dropped into the well instantaneously, so that its entire length will be below the water table. Water level measurements will be taken at logarithmic intervals, and recorded with an electronic data logger, as the water falls back to its initial static level (falling head test). (This test may not provide an accurate measurement of hydraulic conductivities for wells with screens that bracket the stabilized water table. Therefore, falling head test data will generally not be used from such wells unless data analysis indicates an accurate measurement of hydraulic conductivity has been obtained.)

- For all monitoring wells, a rising head test will be conducted by withdrawing the slug from the well once the water level has again returned to static conditions. The water level will be measured in logarithmic intervals, identical to those made for the falling head test.

All measurements will be recorded in accordance with ENSR SOP No. 102Pines – In-Situ Hydraulic Conductivity Testing – Rising and Falling Head Permeability Tests (see Appendix A). The type of test (rising or falling) will be recorded in the slug test log, log book, and/or in the data file.

For quality control purposes, each test will be performed twice. Where water levels have not returned to static levels, tests will not be repeated.

Equipment (e.g., slugs) used for testing will be decontaminated between sampling points as detailed in Section 3.2.6 and in accordance with ENSR SOP No. 7600Pines – Decontamination of Field Equipment (see Appendix A).

The recorded water level changes during the slug test will be downloaded in accordance with manufacturer's instructions. The data will be analyzed using appropriate methodologies (e.g., Bouwer and Rice, 1976; Kansas Geological Survey methods (Hyder, et al., 1994); Cooper, Bredehoeft, and Papadopulos, 1967).

3.3.12 Staff Gauge Installation

Surface water levels may be measured from existing structures, such as bridges, that cross surface water bodies, or at piezometers installed within surface water bodies (see Section 3.3.13 below). In addition, staff gauges may be installed to measure surface water levels.

Staff gauges will be constructed of commercial, stadia-marked gauges mounted on fixed structures. The gauge will be mounted so that the surface water level intersects the stadia markings, allowing a direct reading of the surface water level.

The elevation of both the top of the gauge and the zero point on the gauge will be surveyed.

3.3.13 Piezometer Installation

Piezometers will be used to monitor hydraulic heads (groundwater levels), especially near surface water bodies and wetlands. Where feasible, piezometers can be installed directly in a surface water body, providing a mechanism to measure both surface and groundwater levels.

Piezometers will be constructed of steel with a short length of screen to allow the passage of water. Screen may be factory-slotted, drilled holes, or a mesh screen. The piezometers will be manually driven into the subsurface at the specified locations so that the top of the screen is a minimum of 2 feet below the ground surface. Each piezometer will be capped with a locking screw top.

For the piezometer located in the Type II (North) Area at Yard 520, the piezometer will be placed into a Geoprobe® boring installed for soil sampling purposes (see Section 2.1.4). This piezometer will be grouted at the ground surface with a minimum of three feet of granular bentonite hydrated with clean water to minimize impacts to the function of the clay cap. The piezometer will be protected with a locking, steel protective stand-up casing. This piezometer will be removed at the end of the five measurements specified in Section 2.2.4 in order to best protect the long-term integrity of the cap.

The location and elevation of the top of the piezometers will be surveyed.

3.3.14 Surface Water Flow Measurements

Surface water flow measurements will be made in several locations within the Area of Investigation. Surface water flow measurements will be made by using a Marsh McBirney, Pigmy, or equivalent current-meter. The current-meter will be mounted on a top-setting, weighted rod for ease in placing the current-meter at six-tenths depth from the water surface. It is imperative that the field technician performing the task stand downstream of the current-meter as well as hold the rod as vertically as possible during collection of the measurements.

Several velocity measurements will be recorded across a cross-section of the water body. The selected location will be cleared of all obvious temporary debris, such as sticks. The cross-section will be divided into approximately five to ten compartments. The dimensions (width perpendicular to flow and depth) of each compartment will be measured. The average velocity in each compartment will then be measured using the current-meter. The flow rate at each compartment is the product of the velocity and the cross-sectional area. The total flow at that location is then the sum of the flows calculated at each compartment. This procedure will be performed twice at each cross-section, using a different number of compartments, to provide a check on the accuracy of the measurement.

Field conditions and all measurements and calculations will be collected and recorded in the field logbook and/or appropriate field form.

3.3.15 Surface Water and Sediment Sampling

Surface water and sediment samples will be collected at the locations discussed in Section 2.4. Prior to sampling, fixed sample locations will be established by installing stakes or other permanent markers at the sampling locations. These markers will be used to ensure that samples collected over multiple seasons are collected at consistent locations. Locations will be surveyed by a licensed land surveyor and the GPS locations recorded. Specific procedures for surface water and sediment sampling are provided in ENSR SOP No. 103Pines – Surface Water and Sediment Sample Collection (Appendix A).

All work in or near surface water bodies will be performed by personnel wearing appropriate gear (e.g., hip boots, chest waders) and PPE, as appropriate. If water in a stream is too deep for wading, a water sample will be taken as close to the desired sample point as can be safely reached from shore or shallower depths. Sampling of impounded environments (e.g., ponds) may require use of a small boat.

Surface water and sediment sampling will proceed from downstream to upstream locations. At each sample location, the appropriate sampling device (e.g., beaker, water bottle, jar, spoon) will be decontaminated prior to conducting the sampling. The sampling container will then be rinsed in the surface water, and the rinse water will be discarded downstream of the sampling station.

3.3.15.1 Surface Water Sampling

Surface water samples will be taken prior to sediment samples to prevent sampling re-suspended sediments. Surface water samples will be collected by immersing a clean sampler slowly into the water to just below the surface, as feasible due to depth, and then slowly lifting the sampler (full of water) out of the water without disturbing the bottom sediment. The sample will then be poured into the appropriate sample containers. Specific bottleware is provided in Table 3-1. In deeper pond environments, samples may be taken below the surface at specified depths using an Alpha bottle or Kemmerer sampler.

Water quality parameters will be recorded at the surface water location and include pH, specific conductivity, temperature, DO, and ORP (See ENSR SOP No. 105Pines – Operation and Calibration of the YSI Multi-Parameter Water Quality Monitor; see Appendix A). In pond environments, a vertical thermal profile will be conducted to determine seasonal stratified conditions. Field parameters will be measured by submerging the instrument probe in flowing surface water and recording the measurements after stabilization. Visual observations including color and turbidity will also be recorded. A visual, qualitative estimate of flow will be made.

Where samples are to be filtered, filtering will be conducted in accordance with ENSR SOP No. 7131Pines – Field Filtration of Water Samples for Inorganic Constituents (see Appendix A).

All measurements will be recorded in accordance with ENSR SOP No. 103Pines – Surface Water and Sediment Sample Collection (see Appendix A). Sample documentation, labeling, custody, packaging and shipping procedures will follow the methods as described in Section 3.2.3.

Equipment (i.e., jar, beaker, spoon, etc.) used for sampling will be decontaminated between sampling points as described in Section 3.2.6 and in accordance with ENSR SOP No. 7600Pines – Decontamination of Field Equipment (see Appendix A). Transfer bottles will be disposed of after each sample.

3.3.15.2 Sediment Sampling

The primary sampling objective at each location will be to collect a uniform sample, free of unwanted debris and standing water that is representative of the location from which it came (USEPA, 1998b). Samples will be collected in accordance with the project-specific QAPP and SOP103 (Appendix A) and consistent with USEPA Region I Sediment Sampling Guidance (USEPA, 1998b). The sampling will also be performed in general accordance with the USEPA's, "Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual" (EPA-823-B-01-002) dated October 2001.

After the surface water sample is collected (see Section 3.3.15.1), appropriate equipment (i.e., Russian peat borer (USEPA, 1999)) will be used to collect a sample from the bottom sediment (see ENSR SOP No. 103Pines - Surface Water and Sediment Sample Collection; see Appendix A). Sediment samples will be collected from the sediment surface to a depth of 12 inches with a Russian peat borer, and the sample core will be photodocumented. If sediment depth is less than 8 inches or a uniform clay or sand layer is encountered, a single sample from the 0 to 6 inch interval will be taken. If the sediment depth is greater, a second, deep sediment sample will be taken from the 6 to 12-inch interval. If sediment depth is less than 3 inches, alternative sampling methods (e.g., stainless steel spatula) will be used.

Current USEPA analytical methods for sediment analysis are based on soil samples with percent moistures of less than 10%; whereas typically, sediments average 80% moisture. The increased percent moisture in sediments requires a larger wet weight sample size to obtain valid dry weight adjusted data. To address this issue, some USEPA regional sediment sampling guidance (USEPA, 1998b) recommends decanting all standing water from a sample prior to sample homogenization. Decanted standing water should not include dispersed fine sediments. The sample may be further de-watered by lining a decontaminated stainless steel colander with Whatman #4 filter paper (or equivalent) and spreading the sediment in a thin layer on the filter paper for five to ten minutes. Additional sheets of filter paper may be necessary to sufficiently de-water the sample.

Once the sample is sufficiently de-watered, the sample will be placed into a plastic bucket or container. Data will be recorded regarding sediment texture, odor, colorization, and composition. In addition, detailed field notes will be recorded regarding specific sample locations and conditions. Photographs of sample sites and activities may be taken to document actual locations and procedures. The de-watered samples will then be thoroughly homogenized prior to being placed into the appropriate sample containers as provided in Table 3-1.

All measurements will be collected and recorded in accordance with ENSR SOP No. 103Pines – Surface Water and Sediment Sample Collection (see Appendix A). Sample documentation, labeling, custody, packaging and shipping procedures will follow the methods as described in Section 3.2.3.

Non-disposable equipment (i.e., spoons, colander, bucket) used for sampling will be decontaminated between sampling points as detailed in Section 3.2.6 and in accordance with ENSR SOP No. 7600Pines – Decontamination of Field Equipment (see Appendix A).

3.3.16 HydroPunch® Groundwater Sampling

HydroPunch®, or equivalent, technology will be used to perform the vertical profiling as discussed in Section 2.4.2. HydroPunch® provides temporary locations from which to collect groundwater samples. The HydroPunch® is installed using direct-push (e.g., Geoprobe®) methods, and a number of groundwater samples can be collected vertically at one location. Because these samples are not from properly constructed monitoring wells, the data collected from them will be used only for screening; these data are not appropriate for use in the HHRA or ERA. Analyses of samples from these points may represent biased levels of certain parameters.

Specific procedures for HydroPunch® sampling are provided in ENSR SOP No. 104Pines – Temporary Monitoring Well Installation and Groundwater Sampling by HydroPunch® Technology (Appendix A). Temporary wells will be installed using direct-push methods (e.g., GeoProbe®) by advancing a retrievable stainless steel or disposable PVC screen with steel drop off tip. As the push rods are advanced to the desired depth, the rods are retracted and the encased filter screen is exposed. The exposed screen is then in contact with the groundwater, and samples can be collected.

Due to the construction of the temporary well, groundwater turbidity may be high. Therefore, low flow rates will be used to collect the groundwater samples. General procedures will be conducted in accordance to ENSR SOP 7130Pines – Groundwater Sample Collection from Monitoring Wells (see Section 3.3.10 and Appendix A); however, formal purging and stabilization are not necessary. The use of the flow-through cell will allow for monitoring of field parameters, specifically temperature, pH, and specific conductance. It should be noted that the flow-through cell may become filled with silt due to the nature of the sampling equipment. If the flow-through cell should become full with silt, the pump should be turned off, the flow-through cell emptied, and then rinsed with distilled or deionized water. After the flow-through cell is reconnected, the pump can be turned back on. The process may need to be repeated. The amount of silt within the groundwater samples submitted to the laboratory should be minimized as much as possible. The turbidity of the sample will be measured in the field (ENSR SOP No. 108Pines – Field Measurement of Turbidity; Appendix A).

For the vertical profiling, samples will be collected at 5-foot intervals through the saturated portion of the surficial aquifer. Samples will be monitored in the field for temperature, pH, specific conductance, and turbidity (see SOPs in Appendix A). DO and ORP will also be recorded, although the data are not expected to be representative. At each interval, a sample will also be collected and submitted for laboratory analysis of boron and molybdenum. Because groundwater collected from a Hydropunch® location may not be representative of aquifer conditions and/or what would be expected from a properly constructed and developed monitoring well, the field parameters, like the analyses for boron and molybdenum, are only used for screening level purposes. At each vertical profile location, a monitoring well will be installed that will be used to obtain higher quality data for all parameters (see Table 2-1).

After samples have been collected, the push rods and sampler (excluding the screen and drop off tip) are retrieved to the ground surface.

All measurements will be recorded in accordance with ENSR SOP No. 104Pines – Temporary Monitoring Well Installation by HydroPunch® Technology (see Appendix A). Sample documentation, labeling, custody, packaging and shipping procedures will follow the methods as described in Section 3.2.3.

Equipment (i.e., push rods) used for advancement will be decontaminated between sampling points as described in Section 3.2.6 and in accordance with ENSR SOP No. 7600Pines – Decontamination of Field Equipment (see Appendix A).

3.3.17 Continuous Water Level Monitoring

Continuous water level monitoring will be conducted in selected monitoring wells and at two surface water locations. The continuous water level data will be used to evaluate short-term fluctuations.

Continuous water level monitoring will be conducted using electronic pressure transducers and data logging instrumentation. The locations for such monitoring must be able to be secured. For wells installed with stick-up well completions, all equipment can be locked inside the wellhead. Monitoring equipment at other locations must be protected from disturbance and vandalism.

The equipment will be installed at each location and set up according to the manufacturer's instructions and local conditions. Several days after initial installation, the transducers will be checked to verify that they are recording properly and to verify that the transducer measurements are consistent with the measured water elevation. The data logger will be set to record water levels (to 0.01 feet) at hourly intervals over a one-year period. At regular intervals during that period, field personnel will bring a laptop computer out to each location to download the recorded data. At that time, the instrument programming and measurement accuracy will be checked and adjusted as needed.

4.0 RI SCHEDULE

The planned schedule for field activities, laboratory analytical services, and reporting is outlined in Figure 4-1. As discussed with the USEPA, there are a number of tasks that have already started or will be started prior to USEPA approval of this FSP. These include:

- The MWSE SAP (ENSR, 2004) was prepared to take advantage of the utility trenches for sampling suspected CCBs. The plan was conditionally approved by USEPA in March 2005. Samples were collected under the plan between September 2004 and August 2005.
- The Yard 520 SAP (ENSR, 2005b) was conditionally approved by USEPA in August 2005. Under the SAP, CCB samples will be collected from Yard 520 to evaluate whether certain parameter groups (PAHs, radionuclides, PCDDs/PCDFs) are present in CCBs at concentrations above risk-based screening levels or background levels. CCB samples will be collected from Yard 520 in September 2005.
- As detailed in Section 2.1.8 of this FSP, research will be conducted to identify the aquifer in which private wells in the southern portion of the Area of Investigation are screened. This research has been started and will be completed as soon as is feasible.

The start date for the remainder of the work proposed in the RI is based on the date on which this FSP is approved by the USEPA. Very little of the property within the Area of Investigation is under the control of the Respondents. Therefore, obtaining agreements to access private property is a critical part of the schedule. Access agreements cannot be initiated until proposed sampling locations are approved by USEPA and there is an approved Work Plan that can be referred to by private property owners. The Respondents will make every reasonable effort to obtain access agreements in a timely manner once sampling locations are agreed, but much of the process is beyond their control. The schedule has assumed approximately six months to obtain all access agreements. Obviously, if agreements are obtained earlier, field work may start earlier. All access agreements will be obtained prior to starting field work on private property to avoid multiple mobilizations into the residential areas.

The Respondents have identified certain activities that can begin without obtaining access agreements (e.g., ecological habitat evaluation research, or work along public roadways). These activities will begin after agency approval of this FSP. The start date for the bulk of the field work is based on resolution of access agreements, assumed to take place within six months. Because of access issues, sampling locations may need adjustment during this period. Once all access agreements have been obtained, the bulk of the field activities will begin. The “Project Kickoff” on Figure 4-1 includes tasks such as subcontractor procurement and mobilization of field equipment and supplies, which are shown on the schedule after USEPA approval but not dependent upon access agreements.

This schedule has made assumptions about laboratory turnaround times, times for data validation, and time for USEPA review of any interim deliverables. Completion of these activities within the estimated time periods may be beyond the control of the Respondents. In addition, field work may be subject to delays due to conditions beyond the Respondents' control, such as weather and equipment failures.

The bulk of the field work consists of installing monitoring wells and other sampling stations, then conducting five rounds of monitoring (one per calendar quarter). Groundwater and surface water levels will be monitored five times, with continuous monitoring at selected locations. Continuous water level locations will be selected once the initial round of water quality data has been reviewed (see Sections 2.2.4 and 2.3.2). Groundwater, surface water, and private well samples will be collected on four different occasions. Groundwater sample collection will be scheduled to occur during seasonal high and low water periods, typically March-April and September-October, respectively. The field activities end with demobilization, while field note compilation, any remaining laboratory analysis and other report-preparation tasks continue for an approximate three-month period. As required by AOC II, the RI Report will be submitted to the USEPA 90 days after collection of the final data in the field. It is desirable to meet with the USEPA prior to submission of the RI Report to review the findings and preliminary conclusions of the RI.

It may be necessary for the Respondents to perform a second phase of RI activities to meet the objectives of the RI/FS. If this becomes the case, the Respondents will submit to the USEPA for approval a memorandum documenting the need for additional data, per Section VIII. 32 of AOC II.

5.0 REFERENCES

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